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MODEL 5400/020-030

S-730

DIGITAL VOLTMETER

DANA

Instruction Manual

MODEL 5400/020-030
S-730
DIGITAL VOLTMETER

July - 1966

DANA

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Note

A technical paper, "Ratio Measurement Techniques," is included in the carton containing the instrument. The document discusses measurements involving the comparison or ratio of two voltages and describes techniques to enhance ratiometer performance.

Section 1

General Description

1.1 INTRODUCTION

The Dana Model 5400 Digital Voltmeter, with plug-in module 020 or 030 and equipped with optional accessories, is a multiple function instrument capable of measuring DC volts, DC/DC ratios, millivolts, and AC volts. With Module 030, the additional capability of kilohm measurement is provided. The readings are displayed on a four-digit visual readout with an electrical output available for driving a printer or other recording device. Accuracy is preserved at the range cross-over points by a fifth "overrange" digit that extends each range by 10% (9999 to 10999).

The 020-030 plug-in modules (on the right-hand side of the instrument) are Signal Conditioning units for the Model 5400 Digitizing and Display unit in the left-hand module. The function of the Signal Conditioning Module is to convert the various types of inputs and range selections into ten-volt full-scale DC voltages for measurement in the Digitizing and Display module.

With an 020 module, the digital voltmeter is designated as Model 5400/020; with an 030 module, it is designated as Model 5400/030 (Figure 1.1). Since the two modules are identical except for kilohm measuring capability, descriptions referring to the "020-030 module" apply to both models. Description of kilohm functions apply only to Model 5400/030.

All functions and ranges are selected by switches on the front panel of the Signal Conditioning module. With an instrument equipped with the Model 61 Remote Programming/Electrical Output accessory (optional) the function and range can also be selected externally. This accessory also provides a binary-coded decimal (BCD) output for driving printers or other digital recording devices.

Two additional standard features of the Model 5400 are the Automatic Ranging function and the Analog output. With automatic ranging (Auto Range), circuits within the instrument determine the optimum range for the function being measured and switch to that range automatically. An analog output voltage, proportional to the signal being measured, is available at terminals on the front panel of the instrument. This voltage, at ten volts full-scale, allows analog recordings to be made in parallel with digital measurements. Many other applications for the analog output are possible — including its use as a precision voltage source.

Figure 1.1 - Model 5400

All circuits, other than the power supply, are mounted on plug-in printed circuit boards. The power supply is located at the right rear of the instrument and can be removed as a unit. Next to the power supply is the Model 61 Remote Programming/Electrical Output accessory (Figure 1.2). Two of the printed circuit boards in the Signal Conditioning module are offered as optional accessories. These are the Model 27 AC Converter and the Model 07 Ohms Converter. These boards and the Model 61 accessory may be supplied with the instrument or added at any later time. The circuit boards contained in a fully-equipped instrument are listed below and shown in Figure 1.3. The list is arranged in the order in which the boards are located, starting with those nearest the front of the unit. A block diagram, showing their electrical arrangement, is shown in Figure 1.4.

Digitizing and Display Module	Signal Conditioning Module
Display Decade (1,000) Decade (100) Decade (10) Decade (1) Null Detector Sequence Logic Control Logic Reference and Buffer Amplifier	Control and Attenuator Isolator Range Control AC Converter Auto Polarity Ohms Converter (5400/030 only)

1.2 OPERATIONAL DESCRIPTION

The Dana Model 5400 Digital Voltmeter uses the null balance technique to measure the amplitude of unknown voltages. The Signal Conditioning module converts the input signal to a 10-volt full-scale analog voltage. For example, if the controls are set to measure AC volts on the 100-volt range, a 50-volt rms input signal results in an internal analog voltage of 5 volts DC. This voltage is applied to the Digitizing and Display module where it is "digitized" by comparison with a series of trial-and-error voltages, each of which is a known digital fraction of a reference voltage. Precision resistors in the reference-voltage divider or digital-to-analog converter (DAC) are capable of dividing the reference into 10,000 equally-spaced increments and to arrive at the closest increment in a maximum of 36 trials. The total digitizing time is less than 2 milliseconds.

When a null balance has been achieved, the digital setting of the DAC is displayed on the DVM visual readout. The number shown is, in effect, the ratio between the input signal and the reference voltage in parts per 10,000.

When absolute measurements are being made, a highly stable Zener-controlled, 10-volt internal reference is used. Since full scale analog voltage from the

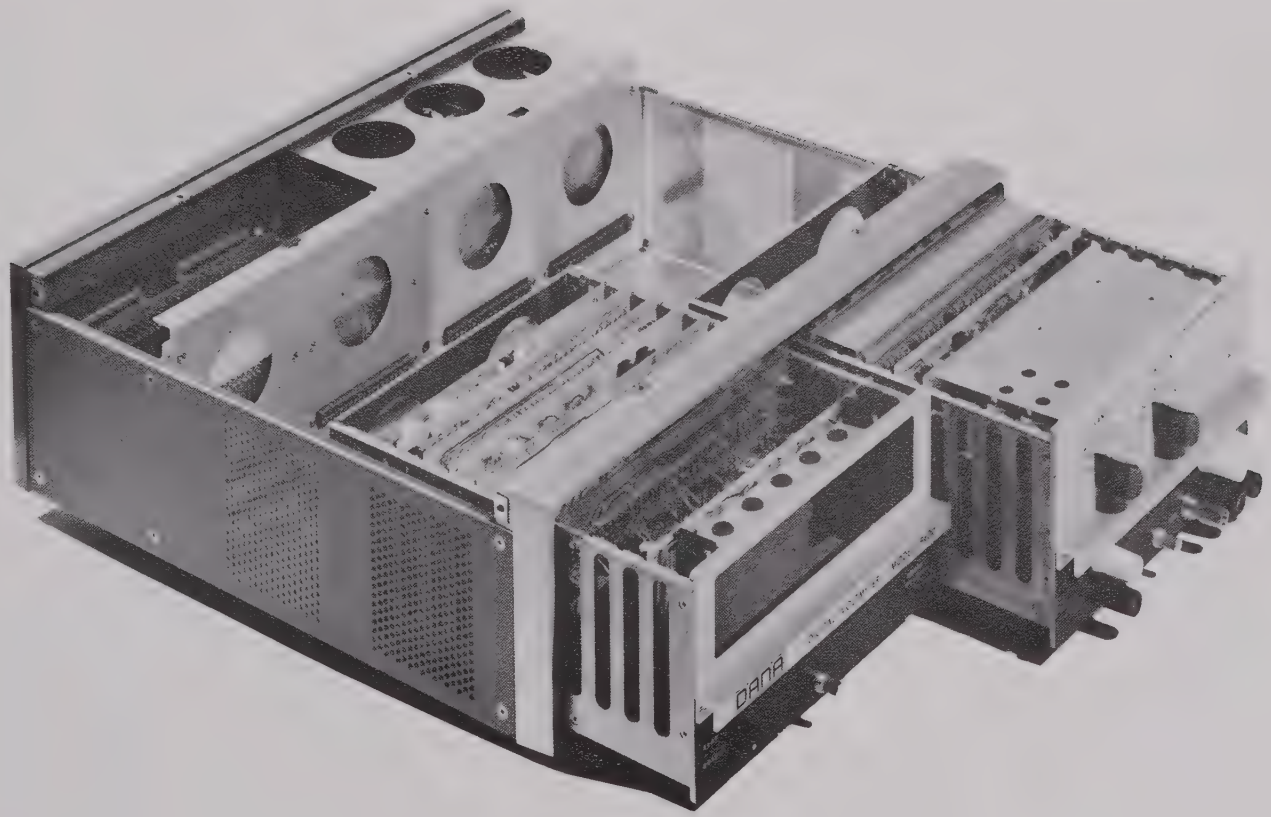


Figure 1.2 - Adding Model 61 Digital Output and Programming Accessory
to Model 5400 Digital Voltmeter

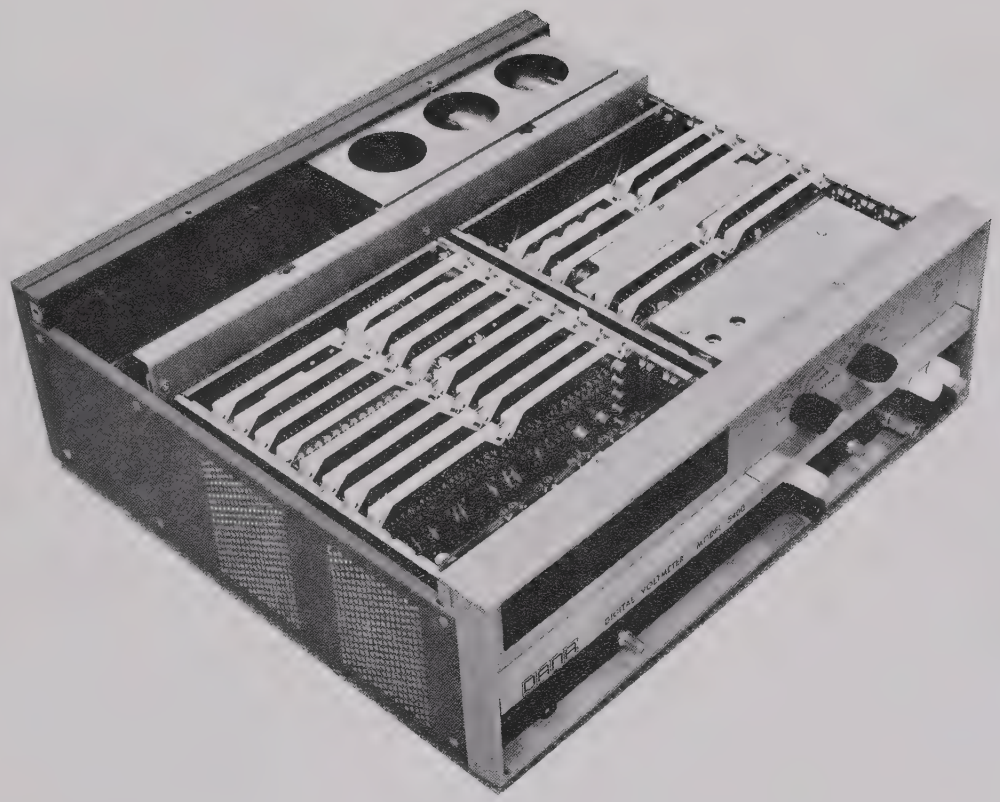


Figure 1.3 - Model 5400/030 With Top Cover Removed

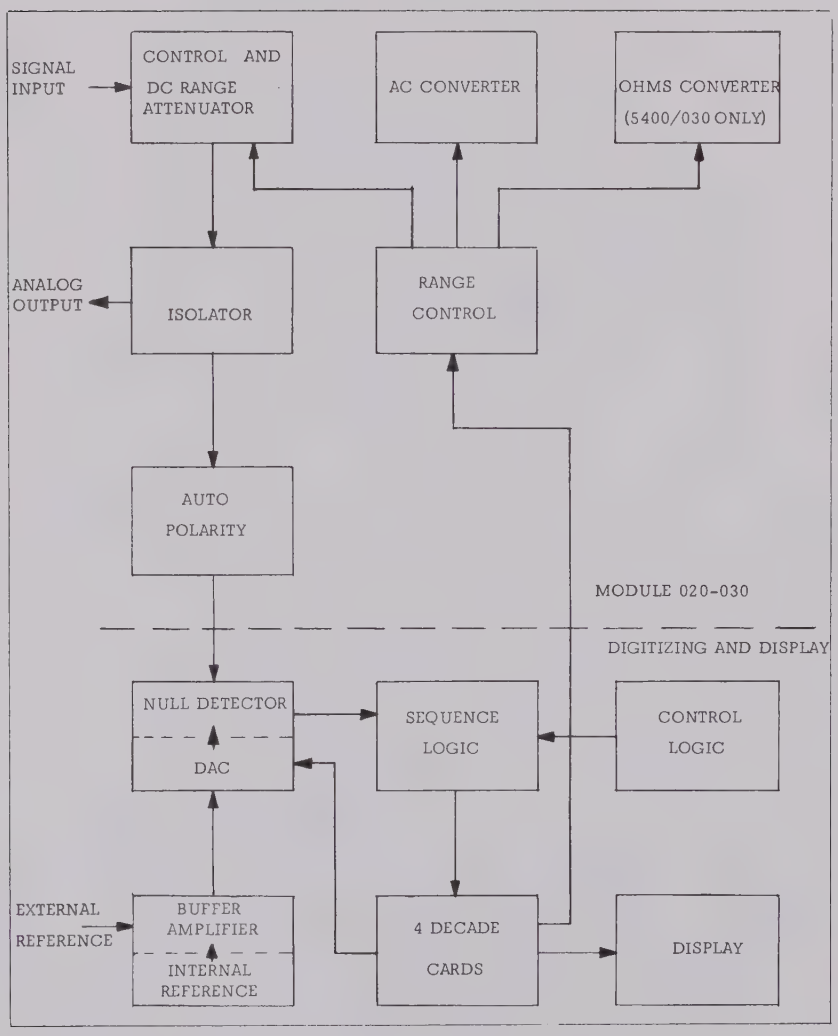


Figure 1.4 - Function of Plug-In Circuit Boards

Signal Conditioning module is also 10 volts, the displayed value is read directly in DC volts, millivolts, AC volts, or kilohms, with proper placement of the decimal point to adjust for any ranging that has been performed.

In the above example, the 50-volt rms AC input signal would produce a 5-volt internal analog voltage, which would be balanced by the 10-volt internal reference when the DAC arrives at a value of 5,000 (parts per 10,000). The digital display would carry the numerals 5-0-0-0, and range information from the Signal Conditioning module would place the decimal point to read 50.00. An indicator symbol on the display would show that AC volts were being measured.

In the ratio measuring mode, the internal 10-volt reference is replaced by an external DC voltage, which may vary from +1 to +11 volts. The displayed value is the ratio between a DC input signal and the reference voltage at that instant. The ratio between +DC voltages and the reference are shown as plus (+) ratios; the ratio between -DC voltage and the reference as minus (-) ratios. This bipolar ratio capability is of particular value in applications, such as bridge balancing, where inputs are likely to pass through zero. Since the signal and reference voltages are being detected simultaneously, the accuracy of the ratio measurement is independent of the stability of the voltage source.

1.3 SPECIFICATIONS

DC VOLTAGE MEASUREMENTS			
		ABSOLUTE (0 to ±1000 v)	RATIOS (+1 to +11 v ref)
Full scale ranges, ranging and polarity automatic*		±10.999, ±109.99, ±1099.9 v (max input 1000 v)	±1.0999:1, ±10.999:1, ±109.99:1
Accuracy		±0.01% of reading and ±0.01% of f.s.	±0.01% of reading and ±0.01 (10v/E ref)% of f.s.
Temperature coefficient		±0.001% of reading per °C	±0.001% of reading per °C
Response time:	Digitizing with polarity change	2 milliseconds	2 milliseconds
	Range change	250 milliseconds per range	250 milliseconds per range
Full scale step function settling time (to 0.01%)		250 milliseconds with up to 100k-ohm source	250 milliseconds with up to 100k-ohm source
Common mode rejection:	DC	error <0.01% per 100 v common mode, with up to 100 ohms in either lead	error <0.01% per 100 v common mode, with up to 100 ohms in either lead
	AC, 61 Hz and below	error <0.01% per 10 v common mode, with up to 100 ohms in either lead	error <0.01% per 10 v common mode, with up to 100 ohms in either lead
Normal mode noise rejection		40 db min, 59 Hz and up; increasing 18 db/octave; 80 db min, 300 Hz and above; three-pole Gaussian	same as absolute (input only)
Input resistance—at or off null:	10 range	1000 megohms	signal, 1000 megohms; ref, 20 megohms
	other ranges	10 megohms	signal, 10 megohms; ref, 20 megohms

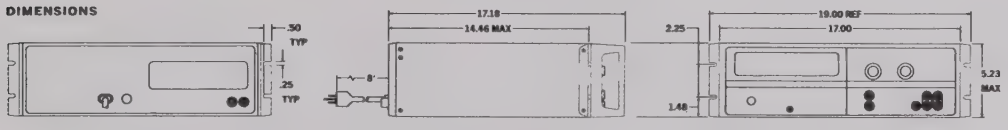
DC VOLTAGE MEASUREMENTS, FAST		
Full scale ranges, ranging and polarity automatic	±10.999, ±109.99, ±1099.9 volts (max input 1000 volts)	
Accuracy	±0.01% of reading and ±0.01% of f.s.	
Temperature coefficient	±0.001% of reading per °C	
Response time: Digitizing with polarity change	2 milliseconds	
Range change	250 milliseconds per range	
Full scale step function settling time (to 0.01%)	50 milliseconds with up to 100k-ohm source	
Common mode rejection: DC	error <0.01% per 100 v common mode, with up to 100 ohms in either lead	
AC, 61 Hz and below	error <0.01% per 3v common mode, with up to 100 ohms in either lead	
Input resistance—at or off null: 10 v range	1000 megohms	
other ranges	10 megohms	

MILLIVOLT MEASUREMENTS		
Full scale ranges, ranging and polarity automatic	±109.99, ±1099.9 millivolts	
Accuracy	±0.01% of reading and ±0.02% of f.s.	
Response time (to 0.01%): Step response	1 second	
Range change	250 milliseconds	
Common mode rejection: DC	error <0.01% per 10 v common mode, with up to 100 ohms in either lead	
AC, 61 Hz and below	error <0.01% per 10 v common mode, with up to 100 ohms in either lead	
Input resistance	100 megohms minimum	

ACCESSORY SPECIFICATIONS		MODEL 27 AC CONVERTER	MODEL 07 OHMS CONVERTER
Maximum voltage rating		500 v rms, 50 Hz to 10 kHz, decreasing to 150 v at 50 kHz and up	not applicable
Maximum voltage across unknown		not applicable	10 v at f.s., max current 10 ma on 1 k range
Full scale ranges, ranging automatic		10.999, 109.99, 1099.9 v rms	1.0999, 10.999, 109.99, 1099.9, 10999 kilohms
Accuracy		50 Hz to 10 kHz: ±0.1% of rdg or ±0.02% f.s.	1, 10 and 100 ranges: ±0.01% of reading ±0.01% f.s.
		10 kHz to 50 kHz: ±0.25% of rdg or ±0.05% f.s.	1000 range: ±0.03% of reading ±0.01% f.s.
		50 kHz to 100 kHz: ±1% of rdg or ±0.1% f.s.	10,000 range: ±0.07% of reading ±0.05% f.s.
Response time:	Step response	0.3 second to within 0.1% of final value	1, 10, and 100 kilohm ranges: 250 ms; 1 meg range: 0.5 sec; 10 meg range: 0.5 sec/meg
	With range change	250 milliseconds per range	250 milliseconds per range
Common mode rejection:	DC	not applicable	error <0.01% per 100 v common mode, with up to 100 ohms in either lead
	AC, 61 Hz and below	error <0.01% per 10 v common mode, with up to 100 ohms in either lead	error <0.01% per 10 v common mode, with up to 100 ohms in either lead
Input resistance (all ranges)		1 megohm in series with 0.22 microfarad	not applicable
Shunt capacitance at terminals		less than 47 pf, all ranges	not applicable

GENERAL SPECIFICATIONS AND ORDERING INFORMATION (MODULES 005, 010, 015, 020, 030)	
Maximum common mode voltage	250 volts
Maximum power requirement	40 watts, 105 to 125 v (export, 210 to 250 v), 50 to 400 Hz
Warm up	1/2 hour to full accuracy
Operating temperature range	0° to +50°C
Signal input binding post connectors	front standard; for front and rear, add -1 to model and module numbers (e.g., 5400-1/030-1)
Reference input binding post connectors	rear only
Analog electrical output (Modules 010, 020, 030 only)	10 v f.s. at 1 milliamp. Accuracy: dc and ohms, ±1 mv; ac as Model 27 above
Digital output and programming accessory*	Model 61 ($175) provides: output 1-2-4-8 BCD with polarity and function ("0" is +10 v, "1" is +1 v); programming (contact closures) range and all functions. Other BCD codes available.
Convenience hardware	Handles, part no. H450820, $15 per set. Rack Mounting Flanges, part no. F450820, $15 per set. Integral Handles-and-Flanges, part no. FH450820, $15 per set. Card Extender, part no. 410184, $15.
Guarantee	12 months, faulty workmanship or component failure

DIMENSIONS



BACK SIDE FRONT

Dana Laboratories Incorporated

6 May 1966

MODEL 5400-S-730

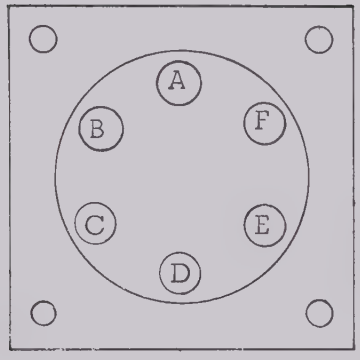
This specification describes a Model 5400. All standard specifications apply except as follows:

1. The voltmeter shall be equipped with a MS3102 rear input connector, #14 shell size.

2. Connections are listed below:

Pin Assignment	Function	
A	Input Hi	White at front
B	Input Lo	Black at front
C	Positive current terminal	White at front
D	Negative current terminal	Black at front
E	Chassis ground	
F	External reference	

3. All mating connectors to be supplied.



A - Input High

B - Input Low

C - Positive Current

D - Negative Current

E - Chassis Ground

F - External Reference

Rear Input Connector

5400-S-730

Section 2

Installation

2.1 UNPACKING AND INSPECTION

The Model 5400 Digital Voltmeter is crated in a plastic foam container consisting of two half-forms joined together and securely taped. The forms are contoured so as to hold the digital voltmeter firmly in place with the container absorbing any reasonable external shock. Before uncrating, examine the container for any sign of external damage.

Carefully cut the tape holding the two half-forms together and remove the digital voltmeter. Inspect the digital voltmeter for signs of damage. If damage is found, notify the carrier immediately.

Remove the two modules from the DVM enclosure by turning the knurled knobs counterclockwise and pulling on the aluminum channel across the front panel of each module. Be sure that all circuit boards are firmly seated in their connectors. Normally, there is no need to remove each board; however, a visual check for obvious damage should be made.

Reseat the modules by pressing them firmly into the connectors at the rear of each drawer assembly. Lock in place by turning the knurled knobs fully clockwise.

The Model 5400, as shipped, is designed for bench-top operation. A standup bracket is provided under the case to aid in reading the visual display. To adapt the Model 5400 for rack mounting, flanges are attached by removing the two screws holding the side panels to the front bezel casting and replacing them with the longer screws provided with the rack-mounting flanges. The flanges are supplied in pairs, with Part No. F-450820 applying to a pair of flanges alone. For integral flanges and carrying handles, specify Part No. FH-450820. For carrying handles only, specify Part No. H-450820.

2.2 POWER CONNECTIONS

A standard eight-foot, three-wire, power cable is supplied with the instrument. This cord connects to a three-pin power connector at the rear of the unit.

2.3 INPUT / OUTPUT CONNECTIONS

2.3.1 Inputs/Analog Output

Signal input and analog output binding posts are located on the front of the digital voltmeter. Binding posts for the reference input, used for ratio measurements, are located on the rear of the unit. Connection to these terminals are made with standard "banana" plugs. Models equipped with a rear input connector (designated as Model 5400-1) use a six-pin cable connector wired in parallel with the front-panel binding posts. The mating connector is supplied with the instrument. See Paragraph 2.4 for instructions on the use of the analog output. Pin assignments of the rear input connector are as follows:

Pin A	Signal Input +
Pin B	Signal Input -
Pin C	Ohmmeter Current +
Pin D	Ohmmeter Current -
Pin E	Not used
Pin F	Not used

2.3.2 Remote Programming/Electrical Output

The Model 61 Remote Programming/Electrical Output accessory fits into the rear panel of the digital voltmeter enclosure (Figure 2.1). It carries two 50-pin connectors. The connector on the right-hand side (as viewed from the rear) is the Digital Output connector, J202. The left-hand connector is the Remote Programming input connector, J204. Pin assignments of each connector are listed in Figure 2.2.

Isolated printers and other digital recording devices may be driven by the voltage-level signals present on the pins of the Digital Output connector. A "one" state on these pins is +1 volt, with reference to Pin 24. A "zero" state is +10 volts. With Pin 25 as a reference, the "one" state is -10 volts and "zero" is +1 volt. Source impedance is 47 kilohms, and in the true state the circuit can accept (current sink) up to 2.5 milliamperes of current. The logic code is 1-2-4-8, with four output lines for each decade and four each for range, polarity, and function. The Model 61 Accessory may therefore be used with any printer that can accommodate a 1-2-4-8 code with negative true logic with up to 11 volt swings. (In the case of the Hewlett-Packard 562A printer, input option 23 should be used.)

The voltage level signals on the output pins track the successive approximation sequence during the digitizing cycle. The printer is inhibited from recording these interim values by a +8 voltage on Pin 23. This drops to +1 volt at the end of the digitizing cycle, serving as a "print" command to the printer.

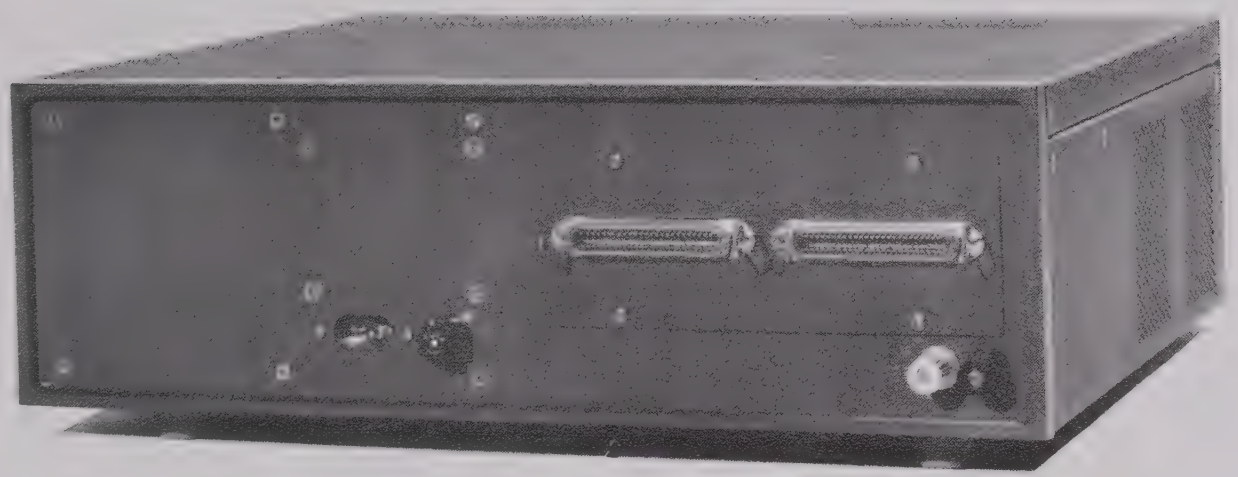


Figure 2.1 - Rear Panel - Model 5400 Digital Voltmeter With Model 61
Digital Output and Programming Accessory Installed

DIGITAL OUTPUT CONNECTOR						REMOTE PROGRAMMING CONNECTOR			
PINS						PINS			
Range	(1)	1	26	Range	(4)	Range 1	1	26	Range 100
Range	(2)	2	27	Range	(8)	Range 10	2	27	Range 1,000
Polarity	(1)	3	28	Polarity	(4)	Range 10,000	3	28	
Polarity	(2)	4	29	Polarity	(8)		4	29	AC Select
Units	(1)	5	30	Units	(4)	Ratio Select	5	30	MV Select
Units	(2)	6	31	Units	(8)	DC Fast Select	6	31	Ohms Select
10's	(1)	7	32	10's	(4)	DC Select	7	32	Hold Select
10's	(2)	8	33	10's	(8)	Read Command	8	33	
100's	(1)	9	34	100's	(4)		9	34	
100's	(2)	10	35	100's	(8)		10	35	
1,000's	(1)	11	36	1,000's	(4)		11	36	
1,000's	(2)	12	37	1,000's	(8)		12	37	
10,000's	(1)	13	38	10,000's	(4)		13	38	
10,000's	(2)	14	39	10,000's	(8)		14	39	
		15	40				15	40	
		16	41				16	41	
Function	(1)	17	42	Function	(4)		17	42	
Function	(2)	18	43	Function	(8)		18	43	
Range 1		19	44	Range 1,000			19	44	
Range 10		20	45	Range 10,000			20	45	
Range 100		21	46				21	46	
		22	47				22	47	
Print Command		23	48			Digit Common	23	48	
		24	49			Range Common	24	49	
Common		25	50			Func. Common	25	50	Digital Common

Code:				
Range 1	4	DC	1
Range 10	3	Ratio	2
Range 100	2	DC Fast	3
Range 1,000	1	AC	4
Range 10,000	0	MV	5
Plus Polarity	1	Kilohms	6
Minus Polarity	2		

Figure 2.2 - Pin Assignments for Model 61 Digital Output and Remote Programming Accessory

Instructions for use of the Remote Programming inputs are included in the "Operation" section, paragraph 3.3.

2.4 ANALOG OUTPUT

The analog output at the front panel terminals is ±10 volts full scale for ±DC signals, both volts and millivolts. It is a +10 volt full scale for kilohm measurements and a -10 volt full scale for AC measurements.

The analog output should drive a minimum 10,000 ohm load, since the maximum full-scale current should not exceed 1 milliampere.

In connecting the analog output to a strip-chart recorder or other analog device, it should be recognized that the black terminal of the analog-output pair is internally connected to the black signal-input connector. Ideally, therefore, floating or isolated recorders should be used to avoid ground loop problems.

2.5 INITIAL CHECKOUT PROCEDURES

Every instrument is completely checked out and calibrated before leaving the factory. The following procedure is performed to verify that no damage has occurred during shipment and that the instrument is operative. Slight deviations in readings during the following tests may be corrected by making simple adjustments. For instructions, refer to "Field Calibration." Any major discrepancies should be reported to the carrier and to Dana Laboratories immediately.

Prior to performing the checkout procedure, it may be advisable to refer to the Operating Instructions, Section 3.

2.5.1 Zero Check

1. Set FUNCTION control to MV and RANGE to 100.
2. Short input leads. Visual readout should display 000.00.

2.5.2 Polarity Gain Check

1. Set FUNCTION control to DC and RANGE to 10.
2. Apply a known voltage of approximately -10 volts to the input. Visual readout should display value of input voltage and proper polarity indication.

3. Reverse polarity of voltage at input (to approximately +10 volts). Visual readout should again display input voltage and proper polarity.

2.5.3 Range Check

1. Set RANGE to 100.

2. Connect input to a source of +100 volts DC.

3. Visual readout should display input value and proper polarity indication.

4. Vary input voltage and polarity and check for proper readout.

5. Repeat on 1000 volt range.

6. Repeat the above steps with range on mV and using 100mV and 1000mV inputs.

2.5.4 AC Check

1. Connect signal generator to input. Set FUNCTION switch to AC.

2. Set generator to 50Hz and check for proper readout at the following input voltages: 9 volts, 90.0 volts, and 125 volts.

2.5.5 Ohms Check

1. Measure standard resistors of values near full scale for each range.

2. Check for proper readout and ohms indication.

Section 3

Operation

3.1 CONTROLS (Figure 3.1)

3.1.1 POWER ON-OFF Switch

This is a pushbutton switch that applies power to the instrument. When Power is ON, the DVM display is always lit. The power switch is independent of both the left- and right-hand drawers. It electrically connects with the power supply at the rear of the instrument.

3.1.2 READ/HOLD Switch

This is a two-position switch that allows the operator a choice of a READ mode, in which new readings are commanded at a fixed rate of four per second, or a HOLD mode, which freezes the last previous reading indefinitely. HOLD is released by turning the switch back to the READ position.

3.1.3 FUNCTION Switch

This is a seven-position switch having the following positions:

1. REMOTE. In REMOTE, the selection of the function to be measured is made externally through the Remote Programming input.

2. FAST DC. This position selects high-speed, non-filtered DC measurements from 1mV to 1000 volts.

3. DC. This position selects medium-speed DC measurements from 1mV to 1000 volts. An input filter is installed in the circuit in this position.

4. 10X RATIO. This position selects the measurement of the ratio of the input voltage, applied across the input signal terminals, to a reference voltage, applied to the reference input terminals at the rear of the instrument.

5. AC. This position selects the measurement of AC voltages from 50Hz to 100kHz.

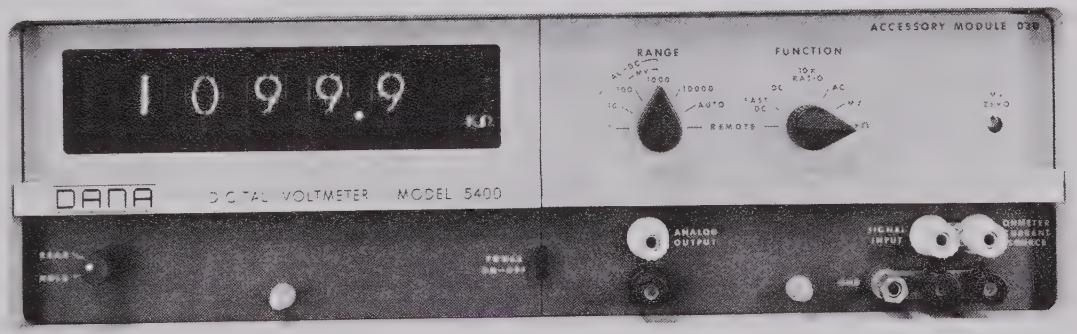


Figure 3.1 - Model 5400 Control Panel

6. MV. This position selects the measurement of low-level DC voltages from 10 microvolts to 1000 millivolts.

7. K-OHM. (On 030 Signal Conditioning Module Only). This position selects the measurement of resistance from 1 ohm to 10 megohms.

3.1.4 RANGE Switch

The RANGE switch has five fixed range positions, an AUTO position, and REMOTE.

Fixed Ranges. The five fixed ranges are 1, 10, 100, 1000, and 10,000. Inscriptions on the panel define the ranges which can be used with particular functions. AC, DC, and FAST DC measurements can be taken on the 10, 100, and 1000 volt ranges. Millivolts can be measured on the 100 and 1000 ranges. Resistance can be measured on all five ranges.

AUTO (Automatic). In this position, range is automatically selected by internal circuits.

REMOTE. In this position, the selection of range is made externally through the Remote Programming input.

3.2 MANUAL OPERATION

The Dana Model 5400 has been designed for the simplest possible level of operation. Once the instrument has been connected to the power line and to the signal source in accordance with the instructions in Section 2, the operator can make all the required measurements by setting the front panel manual controls to the indicated positions.

When switching from one type of measurement to another by turning the FUNCTION control, it is generally advisable to keep the RANGE switch on AUTO so as to avoid overloading the input circuitry. Also, care should be taken to avoid introducing more than 500 volts into the instrument while the FUNCTION switch is on AC, or more than 30 volts while the FUNCTION switch is on MV.

The digitizing time is so rapid that no bothersome flicker occurs on the digital voltmeter display between the four-per-second readings in the "read" mode. With a constant input signal, the display appears to remain fixed. It is therefore normally most convenient to leave the READ/HOLD control on the READ position, using the HOLD position only for special applications, such as external command operation.

3.2.1 DC Measurements, Fast, Normal, and Millivolt

Attach the positive side of the signal source to the white signal input terminal, the negative side to the black signal input terminal. (No damage will occur to the digital voltmeter if this arrangement is reversed, but the automatic polarity indication will be inverted.)

Normally the ground terminal (which is at the DVM chassis ground) is jumpered to the black signal input terminal. If the input signal cable has a shield, this should also be attached to the black signal input terminal. To operate the DVM on a floating basis, detach the ground terminal from the black input signal terminal.

3.2.2 AC Measurements

Attach the high side of the signal source to the white signal input terminal, the low side to the black signal input terminal.

Normally the ground terminal (which is at the DVM chassis ground) is jumpered to the black signal input terminal.

3.2.3 Ratio Measurements

Attach the signal input as for the DC instructions above. Attach the +DC reference voltage with the positive side to the white EXT REF terminal on the rear panel of the instrument. The black EXT REF terminal is tied internally to the black signal input terminal, and this is normally jumpered externally to the ground terminal, which is at DVM chassis ground.

Because the black terminals are tied together, the instrument can by itself make only three-wire ratio measurements (i.e., the reference and signal voltages have a joint common). For four-wire ratio measurements, use a differential amplifier, such as the Dana 3400 or 635. Depending on application, the amplifier will be used on the reference or input.

3.2.4 Ohms Measurements (Model 5400/030 only)

For two-wire ohms measurements, jumper the white ohmmeter current source terminal to the white signal input terminal, and the black source terminal to the black signal input terminal and the ground terminal. The signal leads to the unknown resistance may be connected to either set of terminals.

For four-wire ohms measurements, separate sets of leads are connected to the non-jumpered signal input and ohmmeter-current source terminals. These leads are connected to the unknown resistance in the manner shown in Figure 3.2.

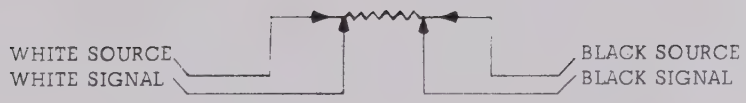


Figure 3.2 - Four-Wire Ohms Measurements

3.3 REMOTE PROGRAMMING

The Model 5400/020-030 may be operated by isolated remote contact closures or by a combination of front panel manual controls and isolated remote contact closures.

Figure 2.3 provides a list of pin assignments for the various instructions that may be programmed. An instruction is transmitted into the instrument by closing a contact between the indicated pin and pin 25. The instructions are not operative, however, unless the corresponding manual control on the front panel is set to its REMOTE position. Thus, to remotely program the range, the RANGE control must be set to REMOTE. The same is true of the FUNCTION control, if the function is to be remotely programmed. It is possible, however, to set one control manually (e.g., the range) while the other is being remotely controlled.

The Model 61 Accessory includes a pin connection for commanding the instrument to take a reading. To enable this command function, the Model 5400 is put in the Hold mode, either by turning the front panel READ-HOLD control to the HOLD position or by providing an isolated contact closure between pin 32 and pin 25. A single reading can then be commanded by a momentary isolated contact closure between pin 8 and pin 25. The instrument immediately initiates a measurement cycle, and holds this measurement until the contact closure at pin 8 is broken and again made.

The Remote Programming feature allows the selection of AC/DC and MV/DC ratio measurements. With the Ratio select line tied to pin 25, the instrument is placed in the ratio measurement mode. With the FUNCTION switch set to AC, the readout will indicate AC and Ratio; measurements of AC/+DC ratio can then be performed. If MV is selected, $\pm$MV/+DC ratio measurements can be performed.

Since no delays are built into the instrument, it is necessary for the external programming mechanism to allow for settling time between the instant that a signal is switched into the input and the command for a printed reading. The required settling times may be determined from the specifications in Section 1.

Section 4

Theory Of Operation

4.1 INTRODUCTION

Theory of operation of the Model 5400 digital voltmeter is described in two parts. First, the Signal Conditioning module is described; then, the Digitizing and Display module. The purpose of the Signal Conditioning module is to supply a negative 10-volt full scale input voltage to the Digitizing and Display module. The Digitizing and Display module measures this input by balancing it against a known fraction of a fixed reference voltage.

The descriptions and simplified diagrams throughout this section are intended to supplement the complete schematics included in Section 6. Logic symbols used in the diagrams are defined in Figure 4.1.

4.2 SIGNAL CONDITIONING

A general description of each circuit board in the module is followed by an operational description of the measurement of each function.

4.2.1 General Description — Circuit Boards

4.2.1.1 Control and Attenuator (Schematic 430310)

The Control and Attenuator is the first assembly behind the front panel. On it are mounted the front panel switches and input/output terminals. The board contains relays which switch polarity, function, and range displays; filters; scaling resistors; and an attenuator for millivolt measurements. The relays are controlled by the function selection — from either the front panel switch or through remote programming — and by the range signals — from either the RANGE switch, through remote programming, or from the Auto Polarity board.

Six relays, K1 through K6, are used. K1 is shown on sheet 1 of the schematic; the others are shown on sheet 2. One side of each relay coil is tied to +28V; the relay is energized by applying a digital common level to the opposite side. The purpose of each relay is indicated in the following table.

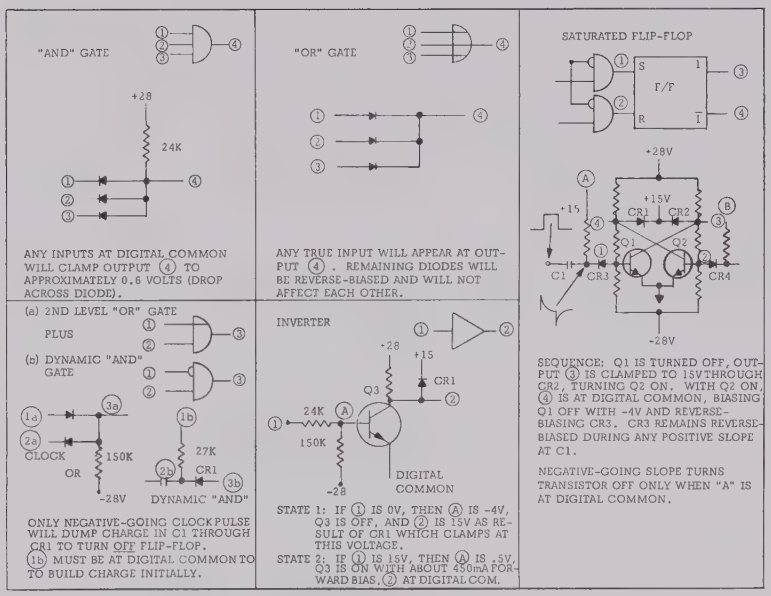

"AND" GATE
+28
24K
ANY INPUTS AT DIGITAL COMMON WILL CLAMP OUTPUT (4) TO APPROXIMATELY 0.6 VOLTS (DROP ACROSS DIODE).
"OR" GATE
ANY TRUE INPUT WILL APPEAR AT OUTPUT (4). REMAINING DIODES WILL BE REVERSE-BIASED AND WILL NOT AFFECT EACH OTHER.
SATURATED FLIP-FLOP
S
R
F/F
1
0
+28V
+15
CR1
CR2
Q1
Q2
C1
CR3
CR4
-28V
SEQUENCE: Q1 IS TURNED OFF, OUTPUT (3) IS CLAMPED TO 15V THROUGH CR2, TURNING Q2 ON. WITH Q2 ON, (4) IS AT DIGITAL COMMON, BIASING Q1 OFF WITH -4V AND REVERSE-BIASING CR3. CR3 REMAINS REVERSE-BIASED DURING ANY POSITIVE SLOPE AT C1.
NEGATIVE-GOING SLOPE TURNS TRANSISTOR OFF ONLY WHEN "A" IS AT DIGITAL COMMON.
(a) 2ND LEVEL "OR" GATE
PLUS
(b) DYNAMIC "AND" GATE
CLOCK
OR
150K
27K
CR1
-28V
DYNAMIC "AND"
ONLY NEGATIVE-GOING CLOCK PULSE WILL DUMP CHARGE IN C1 THROUGH CR1 TO TURN OFF FLIP-FLOP.
(1b) MUST BE AT DIGITAL COMMON TO TO BUILD CHARGE INITIALLY.
INVERTER
+28
+15
CR1
Q3
24K
150K
-28
DIGITAL COMMON
STATE 1: IF (1) IS 0V, THEN (A) IS -4V, Q3 IS OFF, AND (2) IS 15V AS RESULT OF CR1 WHICH CLAMPS AT THIS VOLTAGE.
STATE 2: IF (1) IS 15V, THEN (A) IS .5V, Q3 IS ON WITH ABOUT 450mA FORWARD BIAS, (2) AT DIGITAL COM.

Figure 4.1 - Dana Logic Symbols

Relay	Energized by:	Purpose
K1	DCF selected	Removes active filter A from the input.
K2	Kilohms selected	Routes "current" source directly to Ohms Converter; adds active filter to circuit; installs input resistance in + signal input.
K3	AC selected	Switches high side of input directly to the AC Converter; switches active filter B into the circuit.
K4	MV selected	Switches passive filter into circuit; adds 10K feedback loop to Isolator and adds resistance network to ground.
K5	$\overline{R1}$, R2, K-ohm	Range switching.
K6	$\overline{R2}$	Range switching.

The board also carries the logic circuits necessary to translate the local and remote commands into the appropriate relay responses.

4.2.1.2 Isolator (Schematic 430305)

The Isolator is a floating-input differential amplifier capable of operating at very low signal levels. The feedback loop, that establishes amplifier gain, is located on the Control and Attenuator board. The feedback circuit and the amplifier input are switched into various configurations to conform to the function selected. The amplifier operates as a unity-gain isolator for DC, ratios, and resistance (5400/030 only) measurements; as a gain of 10 amplifier for AC measurements; and as a preamplifier for millivolt measurements on the 100 and 1000 ranges. A simplified drawing of the circuit changes as various functions are selected is shown in Figure 4.2.

Operating in conjunction with the Isolator amplifier is a "bootstrap" amplifier (consisting of Q5, Q6, Q8, Q10, Q11, and Q15, see schematic). This amplifier samples the voltage at the negative feedback point and adjusts the supply voltages to the input stage so that base and collector voltage remain constant. Also it provides a reference level for the first stage base current.

4.2.1.3 Range Control (Schematic 430307)

The Range Control board consists of a three flip-flop counter which generates the range control signals, R1, R2, R3, and their complements. These signals are sent to the other boards throughout the Signal Conditioning module where they energize the proper range relays. The counter is controlled by signals from the Digitizing and Display module (Decade boards). Full-scale, represented by a count of 10999, causes Count Up Range to be "true;" one-tenth scale, represented by a count of 00999, causes Count Down Range to be "true."

The Count Up Range and Count Down Range signals have no effect on the counter except when the output of the Start/Stop Memory (S/S) one-shot is "true." This occurs when the S/S signal (generated in the Digitizing and Display module) goes "false" at the end of a digitizing process. The count signals can be inhibited also by the "forbidden range" logic explained in the following paragraphs. Normally the counter will count up as shown in the following table.

States			
R1	R2	R3	Range
0	0	0	1
1	0	0	10
0	1	0	100
1	1	0	1000
0	0	1	10,000

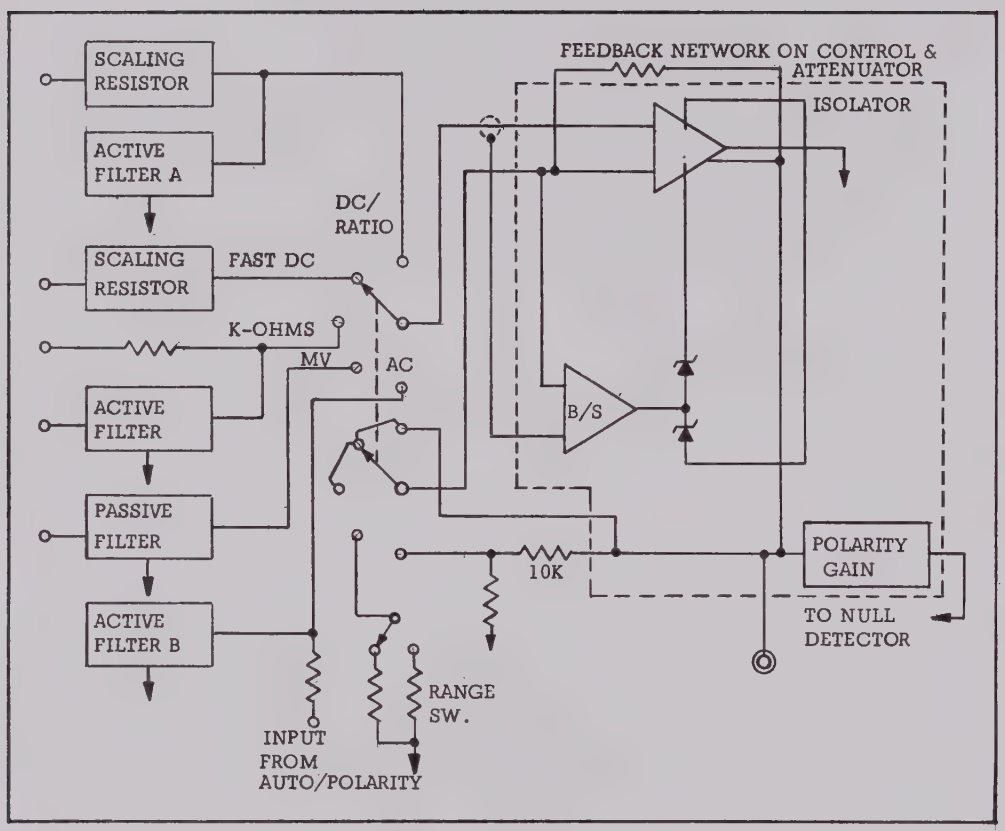


Figure 4.2 - Isolator

Since all ranges are not used for all functions, logic is present to prevent the counter from remaining on a prohibited range for a particular function. For example, with the Millivolt function selected, R2 is not allowed to reset and R3 is held "off" by the MV line applied to R2 and R3 through diodes CR37 and CR38. This allows only the 100 and 1000 ranges to be available with this function selected. Similarly, with the counter at 110 representing the 1000 range, a count-up pulse is inhibited unless the Kilohm function is selected — since that is the only function using the 10,000 range. The input line labeled Z is "true" when either AC, DC, DCF, or Ratio is selected. This line prevents the R3 flip-flop from setting — thereby skipping the 10,000 range.

Any fixed range, selected either manually or remotely, inhibits the automatic range function. This is done by the logic gate at the S/S Memory output.

4.2.1.4 AC Converter (Schematic 430306)

The Model 27 AC Converter is an accessory board that may be plugged into the designated position in the Module (Figure 4.3) at any time. No special wiring or adjustments are required. The AC Converter circuitry consists of an AC-coupled, wideband, low-level amplifier with one permanent feedback path for the 10-volt rms range and two shunt networks, switched into the circuit by reed relays K1 and K2 for the 100- and 1,000-volt rms ranges. The unit is an operational amplifier, with resistor-capacitor pairs at the input and on the feedback loop. The full-scale output, on all ranges, is approximately 3 volts rms for a 10-volt rms input signal.

Another relay, K3, is energized when AC is selected. It reroutes signals from the Isolator and Auto Polarity boards to obtain the proper circuit configuration for the measurement of AC volts.

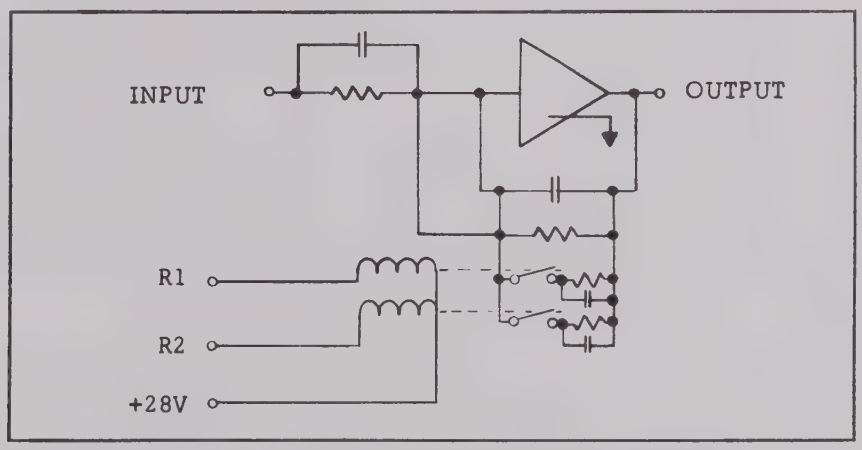


Figure 4.3 - AC Converter

4.2.1.5 Auto Polarity (Schematic 430304)

The Auto Polarity board eliminates the need for polarity switching by maintaining (in conjunction with the Isolator output) a negative input to the Digitizing and Display module regardless of the polarity of the input. A simplified diagram of the Auto Polarity circuit is shown in Figure 4.4. The circuit consists of an inverting amplifier with polarity dependent feedback paths. The input resistor and feedback resistors are equal, resulting in unity gain.

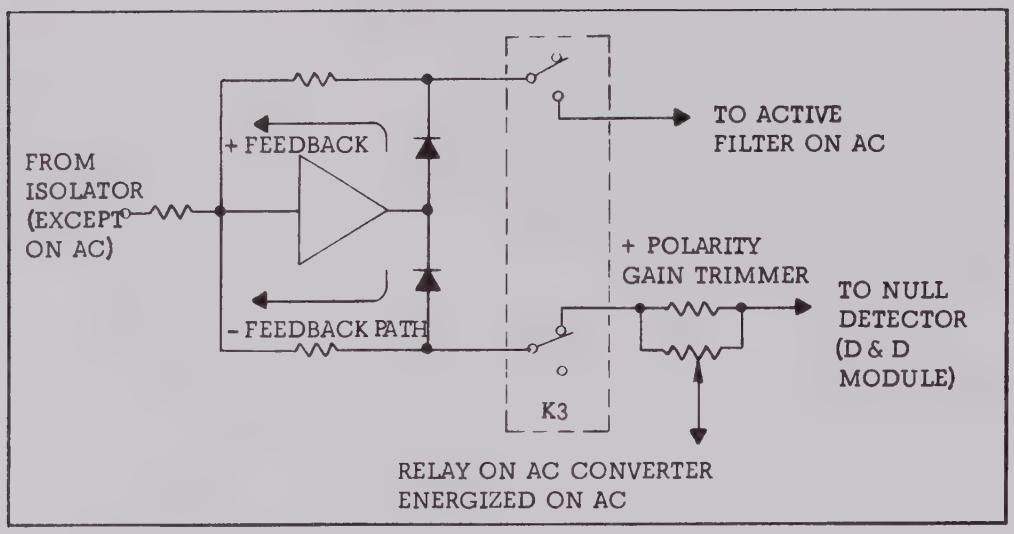


Figure 4.4 - Auto Polarity

The input to the Auto Polarity board from the Isolator is of the same polarity as the input. It is scaled to 10 volts, full scale. A positive input to the Auto Polarity amplifier produces an equal negative voltage on the negative feedback path and zero volts on the positive path; a negative input voltage produces zero voltage on the negative path and an equal positive voltage on the positive feedback path. The input to the Null Detector is taken from only the negative feedback path. Therefore, the voltage at the positive gain trimming resistor is either zero (with negative input) or -10 volts full scale (with positive input).

With AC function selected, the input to the Auto Polarity board is from the AC Converter rather than from the Isolator and relay K3 is energized. The circuit then operates as a half-wave rectifier; a filter is connected through the relay contacts from the positive feedback path. Relay K3 is energized by the selection of AC. Other contacts on the same relay rearrange the circuit configuration as described under "AC Measurement," paragraph 4.2.5.

4.2.1.6 Ohms Converter (Schematic 430303)

The Ohms Converter board (Figure 4.5) produces a constant and precise current which passes through the unknown resistance. The voltage drop across the resistance is determined by the voltage measuring circuits and displayed in Kilohms. The principal circuit element on the Ohms Converter board is a bridge differential amplifier. The voltage across the input terminals is the 10-volt buffered internal reference generated in the Digitizing and Display module, referenced to the Isolator amplifier output. The output of the Ohms Converter amplifier is directed to the Isolator input through a network of current-determining "full-scale" resistors. The effect is to maintain a constant 10 volts across the

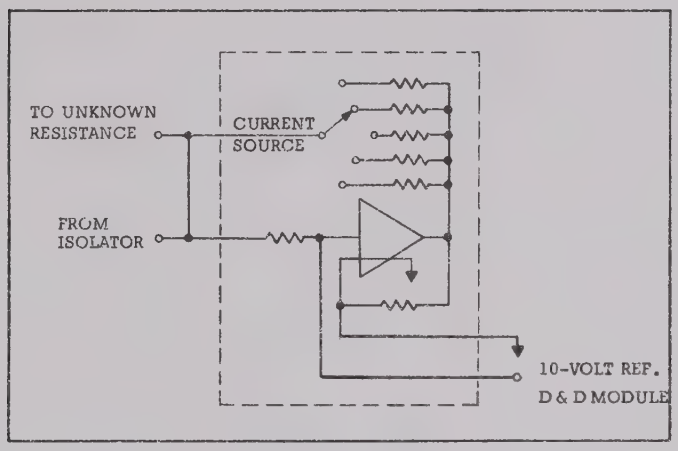


Figure 4.5 - Ohms Converter

full-scale resistors, regardless of the output of the Isolator amplifier. A 10-meg range resistor is constantly in the circuit. The other four resistors are inserted in parallel by the range relays.

4.2.2 Measurement of DC Volts and Ratios

The circuit configuration used for the measurement of DC volts is shown in Figure 4.6. (Note that the diagram is arranged to show the physical location of the boards. Locations, from left to right, represent module locations from front

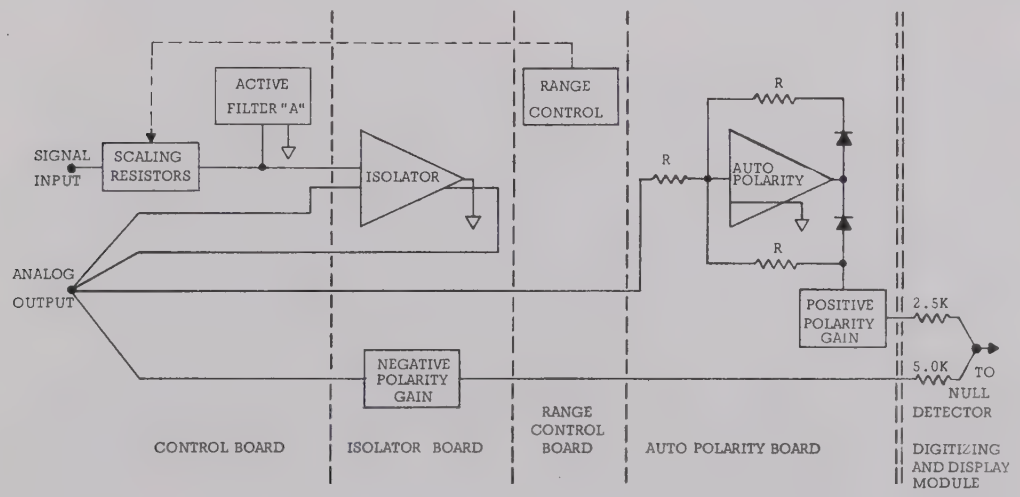


Figure 4.6 - Module 020-030 Block Diagram, DC & Ratio Modes

to rear). An identical arrangement is used when the instrument is in the ratio-measuring mode. The difference in these two types of measurements lies in the counter-balancing reference used in the Digitizing and Display module. DC volts are measured against a fixed internal reference; ratios are measured against an external reference.

As explained previously, the purpose of the Signal Conditioning module is to produce a negative 10-volt full scale signal (-10.999, including over-range) at the input of the Digitizing and Display module. The negative voltage is applied across precision resistors to produce a current that is nulled by an opposite current generated by the reference voltage.

The first step is to scale the incoming DC signal to 10 volts full scale. The precision scaling resistors in the Control and Attenuator circuit divide the input voltage by 10 if the signal is between $\pm$10.999 and $\pm$109.99 volts, and by 100 if the signal is between $\pm$109.99 and $\pm$1,000 volts. The 10-volt full scale input is then filtered to remove superimposed noise and fed into the input of the Isolator. The Isolator is, in this mode, a unity gain amplifier. Its output is therefore identical in polarity and amplitude with the scaled input. The voltage is directed in parallel to two destinations: the input to the Null Detector via a 5,000-ohm resistor, and the input to the Auto Polarity amplifier.

As shown in Figure 4.4, only the negative-voltage feedback leg of the Auto Polarity amplifier is used. Since the amplifier is unity gain inverting, a negative voltage equal in amplitude to the isolator output is present only when the Isolator output is positive. When the Isolator output is negative, there is no signal output from the Auto Polarity amplifier since the positive-voltage loop is carrying the feedback. The Auto Polarity amplifier is connected to the null detector input via a 2,500-ohm resistor.

The current into the Null Detector, then, has two potential sources. If the input signal is negative, the Isolator output is negative and the Auto Polarity output is zero, and all of the required negative voltage is from the Isolator. On the other hand, if the input signal is positive, the Isolator output is positive and an equal negative voltage is generated by the Auto Polarity circuit. However, the resistance on the Auto Polarity leg of the null detector input is only half that of the Isolator leg. Therefore, the current resulting from the negative Auto Polarity voltage is exactly twice that of the current generated by the positive output of the Isolator. The net is a "negative" current that is precisely the same amplitude as the "positive" current that would be generated by the Isolator voltage alone.

The Auto Polarity amplifier derives its name from the fact that it allows the Null Detector to deal exclusively with negative currents from the Signal Conditioning module, without any delay for polarity switching. This is of particular importance when the instrument is being used in the ratio mode and the signal is frequently passing through zero, as in the case of bridge balancing.

Field calibration includes trimming of the 5,000- and 2,500-ohm resistances at the Null Detector input by adjusting potentiometers on the Isolator and Auto Polarity boards (Polarity Gain adjustments). With a negative standard voltage input, only the Isolator voltage to the Null Detector is involved; the negative Polarity Gain adjustment on the Isolator is therefore calibrated first. When a positive standard-voltage input is applied, both current sources are contributing to the Null Detector input and, since Negative Polarity Gain has already been calibrated, the Positive Polarity Gain on the Auto Polarity board is adjusted for positive input voltages.

It is important to note that the Positive Polarity Gain adjustment is used to calibrate positive input voltages; however, the actual polarity voltage affected by this adjustment is always negative (or zero). By contrast, the Negative Polarity Gain adjustment is dealing with the Isolator output, which may be positive or negative, depending on the polarity of the input signal.

4.2.3 Measurement of Fast DC Volts

When Fast DC measurements are being made, the configuration of the Signal Conditioning module is the same as for DC measurements except that Active Filter A is removed. Elimination of the filter allows the instrument to settle to within 0.01% of the final reading in 50 milliseconds, after a step-function change in input level. The filter slows the settling time down to 250 milliseconds. Other than this change at the input, the fast DC mode is identical to that of the standard DC and ratio measurements.

4.2.4 Measurement of Millivolts

Module 020-030 "expands the scale" by switching the function of the isolator circuit, changing it to a preamplifier. Figure 4.7 illustrates the change in configuration from that shown in Figure 4.6.

A 10-kilohm feedback loop is added to the amplifier. This, in conjunction with a resistance network to ground, switches the gain of the amplifier to either 10 or 100. At a gain of 10, the instrument is operating at 1,000 millivolts full scale; at a gain of 100, the full scale is 100 millivolts and the last digit resolution is 10 microvolts.

A passive filter is used at the input to attenuate superimposed noise. Otherwise, the balance of the millivolt circuitry is identical to that used in measuring DC volts and ratios.

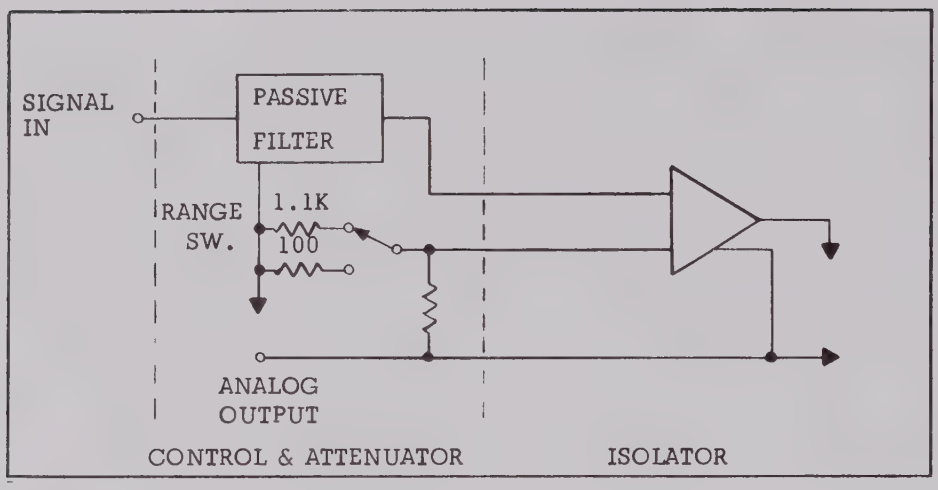


Figure 4.7 - Circuit Change for Millivolt Measurement

4.2.5 Measurement of AC Volts

The measurement of AC volts involves the addition of the AC Converter Amplifier and a major reorganization of the balance of the circuitry. Figure 4.8 illustrates this configuration.

The AC input signal is applied directly to the capacitor-coupled AC Converter Amplifier. The principal purpose of this amplifier is to scale the input down so that the output of the stage is approximately 3 volts rms for a 10-volt rms, full-scale input signal. Input voltages in the 10-to-100 and 100-to-1,000 ranges are reduced by factors of 10 and 100, respectively.

The scaled-down voltage is applied to the Auto Polarity amplifier, which half-wave rectifies it and produces a negative voltage that is $1/\pi$ of the input. A 10-volt rms full-scale input to the instrument is now reduced by exactly 1/10, to -1 volt.

The output of the Auto Polarity amplifier is filtered by active filter "B" on the Control and Attenuator Assembly board and then applied to the Isolator, which has been set to a gain of 10 (using the feedback resistors and attenuators that established the 1,000-millivolt range in the mV mode). The amplified negative voltage is, at this point, a 10-volt full-scale analog of the rms value of the AC input. It is fed directly to the current-determining 5,000 ohm resistor at the input to the Null Detector.

4.2.6 Measurement of Ohms (Model 5400/030 Only)

The ohms measurement configuration of the Signal Conditioning module is similar to that used in the measurement of DC volts and ratios. The Ohms Converter board has the primary function of generating a constant and precise current, which

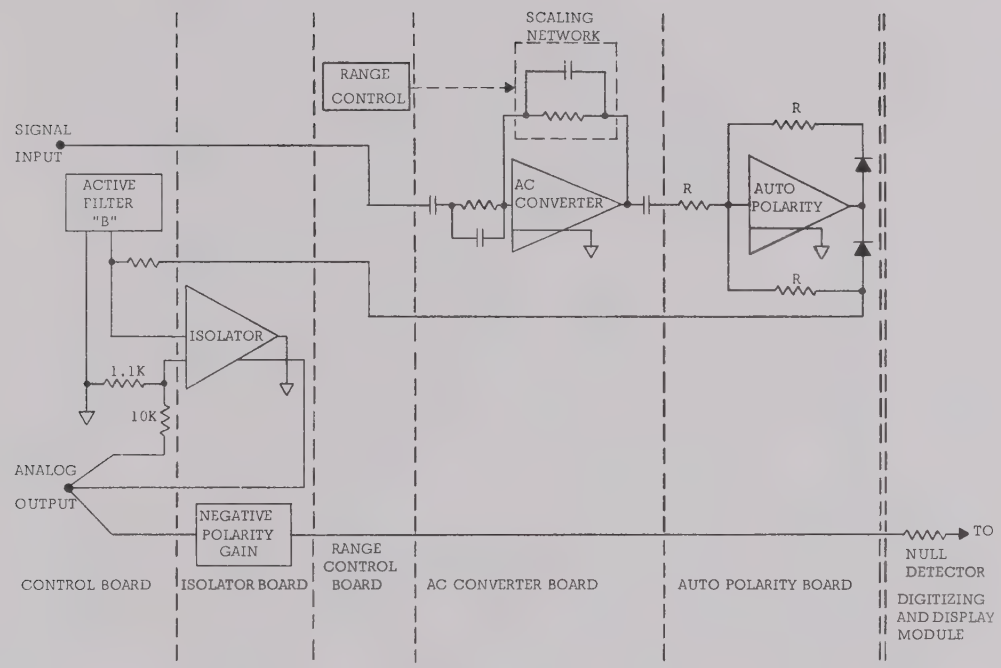


Figure 4.8 - Module 020-030 Block Diagram, AC Mode

is then passed through the unknown resistor. The DC-measurement circuits determine the voltage drop and display the result as kilohms.

Figure 4.9 illustrates how the ohms converter is tied into the balance of the circuitry. The "constant" voltage applied across the full scale resistors is, in effect, the 10-volt reference voltage used in the null balance circuitry in the "Digitizing and Display module. It is "bootstrapped" to the Isolator output, and the result is a constant 10 volts across the selected full scale resistor.

If the unknown resistance is exactly equal to the value of the full-scale resistor, the signal input leads will detect a $\pm$10-volt signal, matching the 10 volts across the full scale resistor. If there is zero resistance in the external circuit, the input leads will detect a zero voltage drop.

4.3 DIGITIZING AND DISPLAY MODULE

A simplified drawing of the Model 5400 Digitizing and Display module is shown in Figure 4.10. Inputs from the Signal Conditioning module are applied to a summing junction at the input to the Null Detector. Regardless of the polarity of the voltage being measured, the sum of the currents from the Signal Conditioning

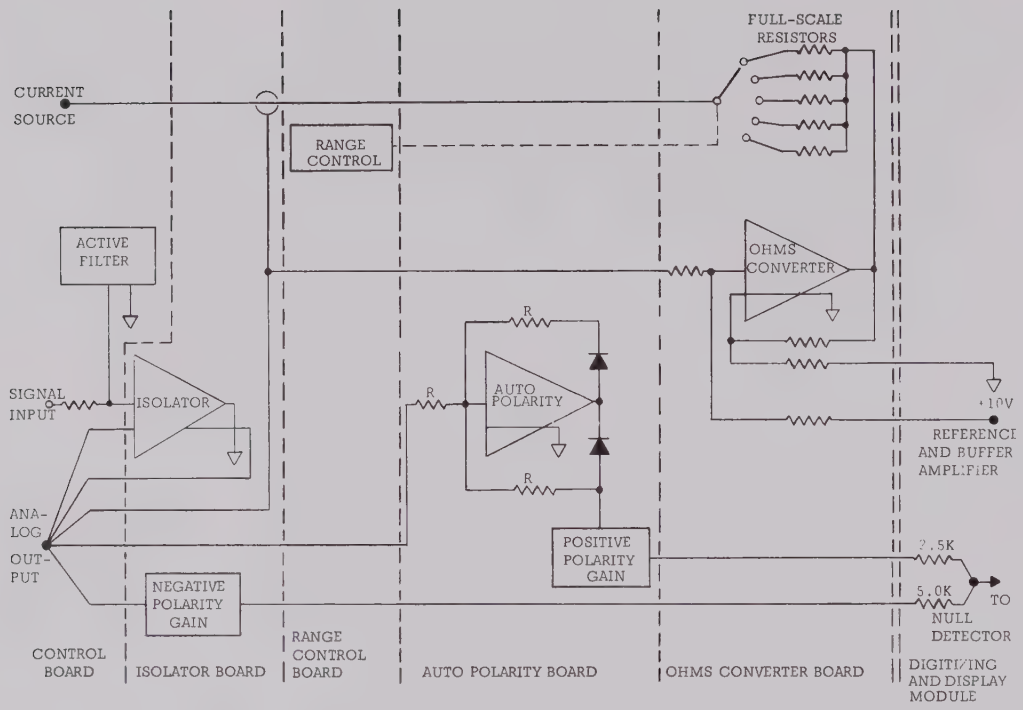


Figure 4.9 - Module 030 Block Diagram, Ohms Mode

module is always -2mA, full scale. This current is combined with a positive current from the DAC (Digital/Analog Converter) circuit.

DAC current supplied to the summing junction is the analog equivalent of the digital value represented by the state of the Decade flip-flops. When the summing junction is brought to null, the state of the flip-flops indicates the exact digital value of the input signal.

The digitizing process, or "conversion," begins when the Start/Stop flip-flop (on the Control Logic board) is set. Start/Stop is set by either of two conditions. The Display Rate circuit turns it on automatically every 250 milliseconds unless inhibited by a ground level at the Ground Hold input (READ/HOLD switch on HOLD) or a ground level at the Accessory Hold input. Start/Stop is also set by an External Command received through the remote programming input — or by an accessory command if the instrument is so equipped.

As Start/Stop is set, the negative-going edge of START/STOP sets the Reset flip-flop. RESET is inverted to become S9 (Set 9) and applied to each of the Decades. Each Decade has four flip-flops representing 2*-4-2-1 for that Decade. S9 sets the Decades to 9999. If, with the four Decades set to nines, DAC current is less than the input, the Overflow flip-flop is turned on by Overflow detecting logic

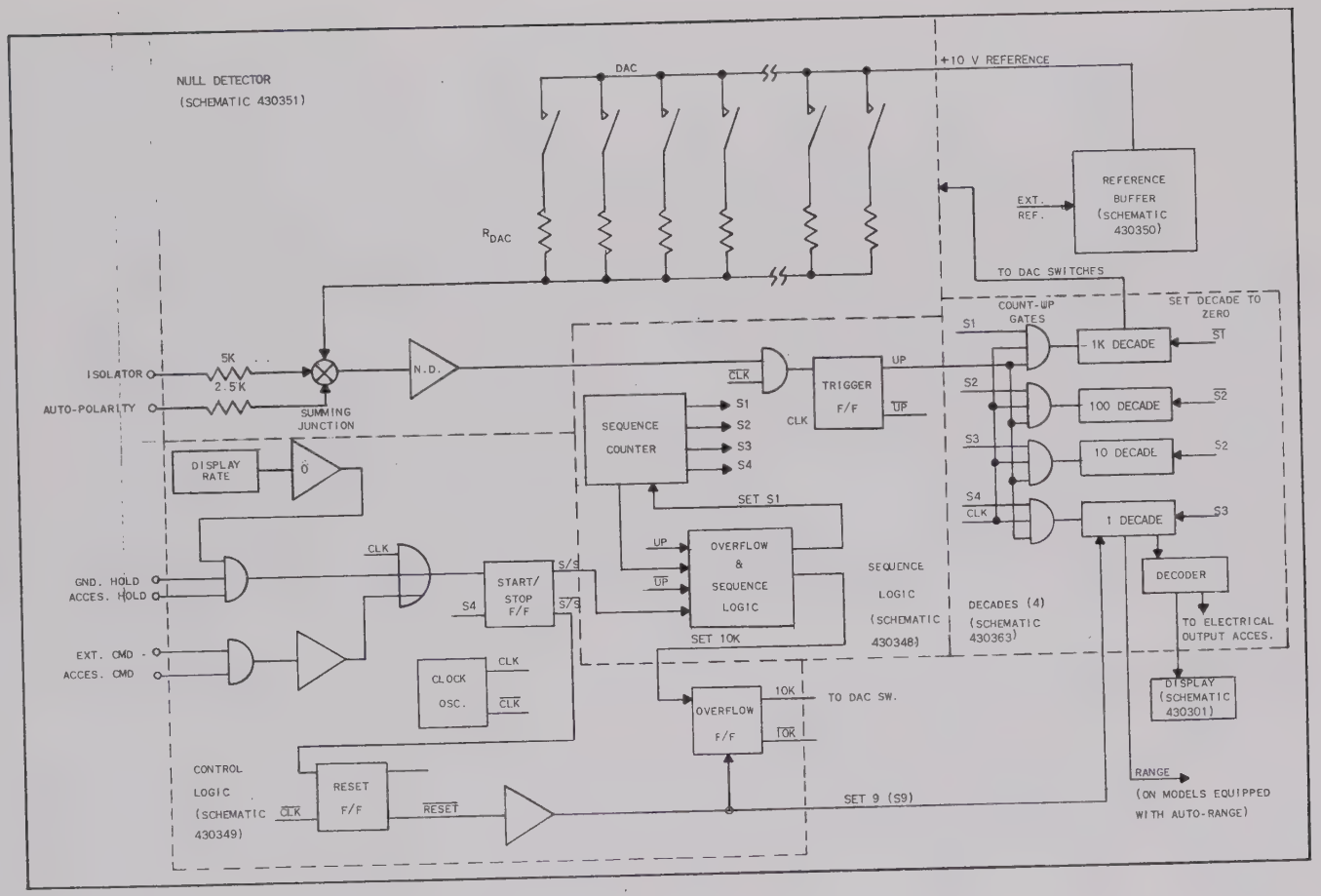


Figure 4.10 - Block Diagram — Digitizing Module

on the Sequence Logic board. This adds additional DAC current representing a fifth digit (10K). If the resulting DAC current is still too low, the digitizing cycle is completed and the unit is made to up-range. If no higher range is available or permitted, the overrange condition (10999) may be printed to indicate an excessive input.

Normally, however, the initial setting of 9999 results in a DAC current greater than the input current. This condition is detected by logic on the Sequence Logic board; the Sequence Counter is stepped to sequence state 1 (S1).

In S1, the 1K Decade is "dropped" (each flip-flop "off"). The Decades are now set to 0999. If the resulting DAC current is less than the input current, the Null Detector causes the generation of UP at the Trigger flip-flop. The 1K Decade now counts up on each clock pulse until DAC current becomes equal to or greater than the input current. This condition is indicated by UP going "false." The Sequencer then advances to S2 and the 100 Decade is "dropped." If DAC current is less than the input current, the 100 Decade is counted up in the same manner as the 1K Decade. This is repeated for each succeeding Decade. At the end of S4, during which the 1 Decade is counted up, the Start/Stop flip-flop is turned off. At this time, the state of the Decades represents the digital value of the input signal and the conversion is complete. This operation is illustrated in the timing diagram of Figure 4.11. In the illustration the input is 03456.

4.3.1 Null Detector (Schematic 430351)

There are two main elements on the Null Detector circuit board (Figure 4.12): the precision DAC (digital/analog converter) resistor matrix controlled by the state of the Decade flip-flops — and the Null Detector itself, an amplifier that detects and amplifies any difference in input current and DAC current.

A summing junction at the input to the Null Detector receives inputs from the Signal Conditioning module. The input voltages are such that the sum of the current through the two input resistors is always negative. This can be seen by considering full-scale inputs to the instrument of both polarities (scaled to 10 volts). With a negative input voltage, the Auto Polarity voltage is zero. Therefore, the current through the 2.5K resistor is zero. The Isolator output is -10 volts; therefore, current through the 5K resistor is -2mA (-10/5K). With a positive input voltage, the Auto Polarity output is 10 volts applied back through the negative feedback leg of the Auto Polarity amplifier. This results in current through the 2.5K resistor of -4mA. At the same time the Isolator output is +10 volts resulting in +2mA through the 5K resistor (10/5K). The sum of the two currents (-4mA and +2mA) is -2mA.

The negative current is balanced out by a positive current from the DAC resistor network. This current is developed from a precise 10-volt reference voltage from the Reference Buffer circuit board for absolute measurements or from an external

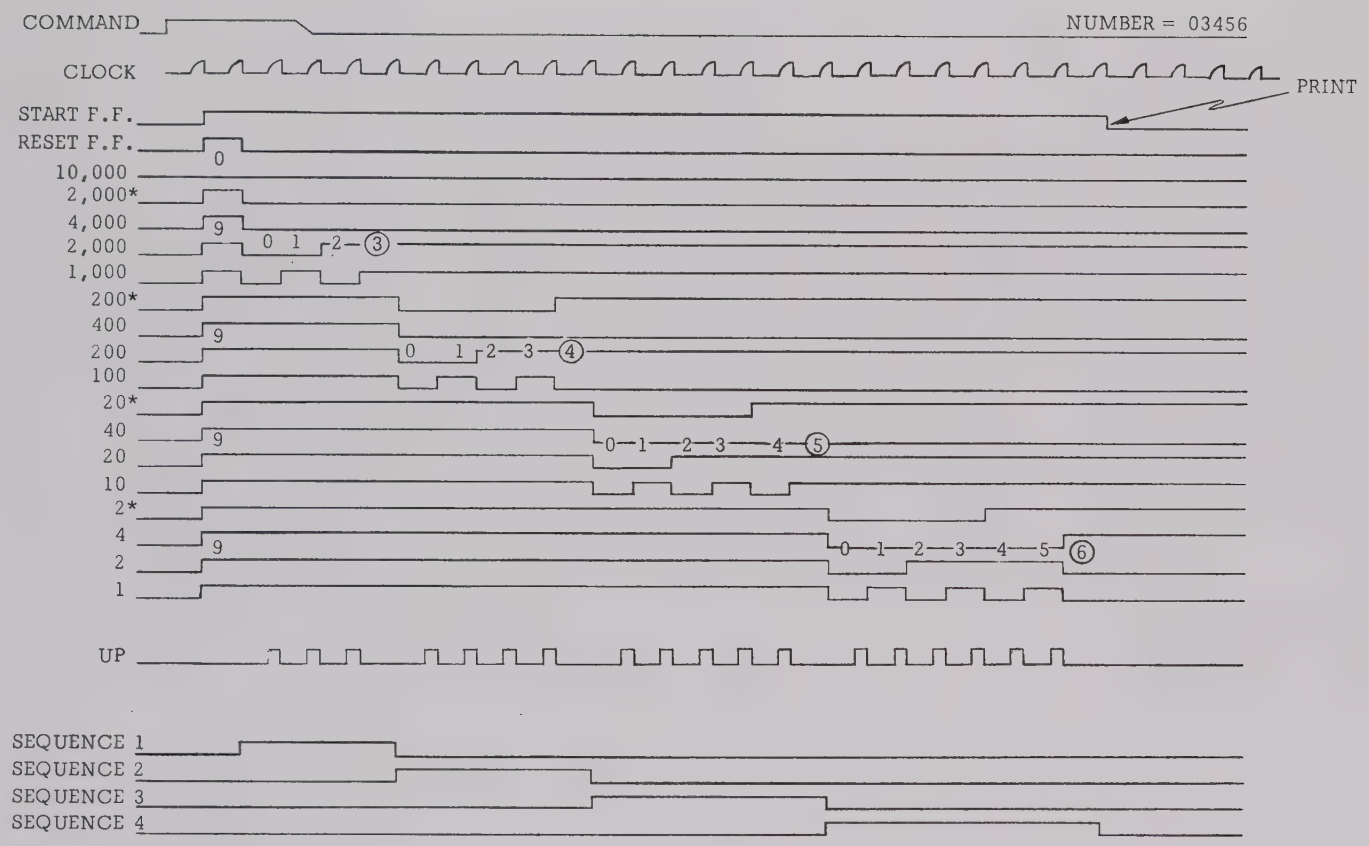


Figure 4.11 - Model 5400 Timing Diagram (Without Over-Range)

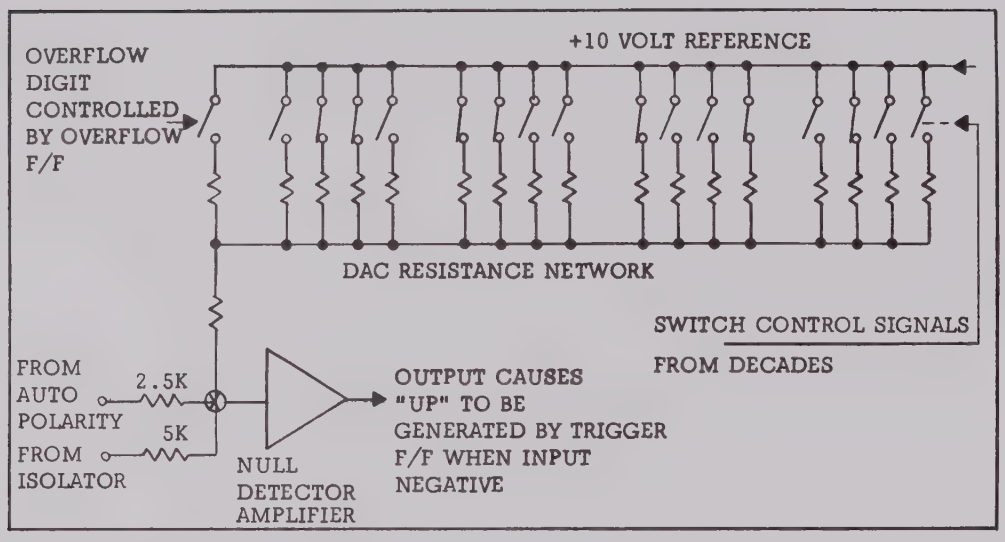


Figure 4.12 - Null Detector

reference when ratios are being measured. In the initial condition where all four Decades are set to 9, the resistors are all switched into the DAC circuit. Since the resistors are in parallel, the resulting DAC current is maximum.

A typical DAC switch is shown in Figure 4.13. Q2 is normally on and R DAC is in the circuit. When a positive voltage is applied to the base of Q1, Q1 is turned on and the resulting ground level at the base of Q2 back biases Q2 and R DAC is out of the circuit. As shown in the figure, the switch is operated by the "not" side of the Decade flip-flop. When the flip-flop is "off" ("not" side true), the resistor is out of the circuit. Therefore, as a decade is counted up, resistance is added in parallel and DAC current increases at each step.

The positive DAC current is applied to the summing junction at the Null Detector input. If the DAC current is greater than the negative current from the Signal Conditioning module, the resulting current is positive; if the Signal Conditioning input is greater, the resulting current is negative. The Null Detector is a high-gain amplifier that provides an output of sufficient amplitude to trigger the Trigger flip-flop only when the input (summing junction) is negative. The Trigger flip-flop is located on the Sequence Logic board; its output is the UP signal. UP and its complement, $\overline{UP}$, control generation of the sequence states which, in turn, control the counting operation of the Decades.

4.3.2 Decades (Schematic 430363)

There are four Decade boards in the instrument, all identical. The Decade board nearest the front of the instrument controls the 1000 digit; the second board the 100 digit; the third, the 10 digit; and the fourth, the 1 digit.

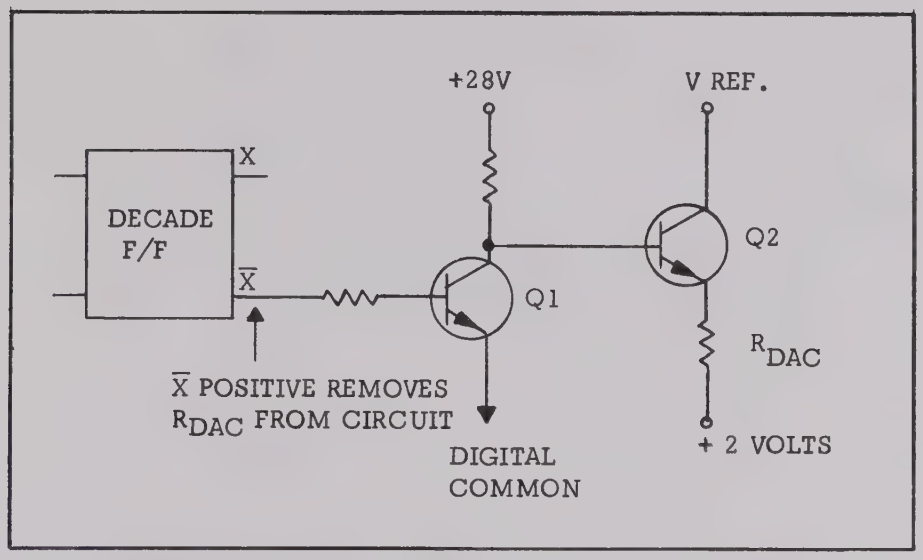


Figure 4.13 - Typical DAC Switch

A simplified drawing of a typical Decade counter is shown in Figure 4.14. At the beginning of a conversion, after the Start/Stop and Delay flip-flops are set, the S9 line is made "true." This applies a positive voltage through R to the reset side of each flip-flop. This voltage sets each flip-flop and represents the "jam to nine" condition. If the Null Detector indicates that 9999 is greater than the input signal, the Sequence Logic places the instrument in sequence state 1 (S1). S1 is applied to the C_O input of the 1K Decade. As S1 goes "true," the negative-going edge of S1 places a negative voltage on the reset input of the flip-flop, thereby resetting it to zero. The "true" output of the flip-flop and of each remaining flip-flop on the Decade resets the following flip-flop as it goes "false" (on negative-going edge). Each flip-flop on the 1K Decade is now "off" and the value represented by the four Decades has changed from 9999 to 0999. S1 is applied to the input gate along with UP and a clock pulse. The Decade counter now counts up on each clock pulse. (SX, shown on the diagram, represents S1 to the 1K Decade, S2 to the 100 Decade, S3 to the 10 Decade, and S4 to the 1 Decade). Counting continues until UP goes FALSE. At this time, the Sequence Logic places the instrument in sequence state 2 (S2) and the 100 Decade is reset by S2 applied to the C_O input. The count-up operation proceeds exactly as in the 1K Decade, except that the input gate is now enabled by S2. The 10 Decade and 1 Decade counting operations begin on following UP signals. At the end of the 1 Decade counting operation (S4), the Sequence Logic counter and Start/Stop flip-flop are reset and no further sequence states are generated until the Start/Stop flip-flop is again set.

The "and" gates at the inputs to the 2 and 2* flip-flops adjust the count to eliminate "forbidden codes." Additional gates on the board receive various outputs from the flip-flops to detect the 0 and 9 states of the Decade for use of the range circuits in the Signal Conditioning module.

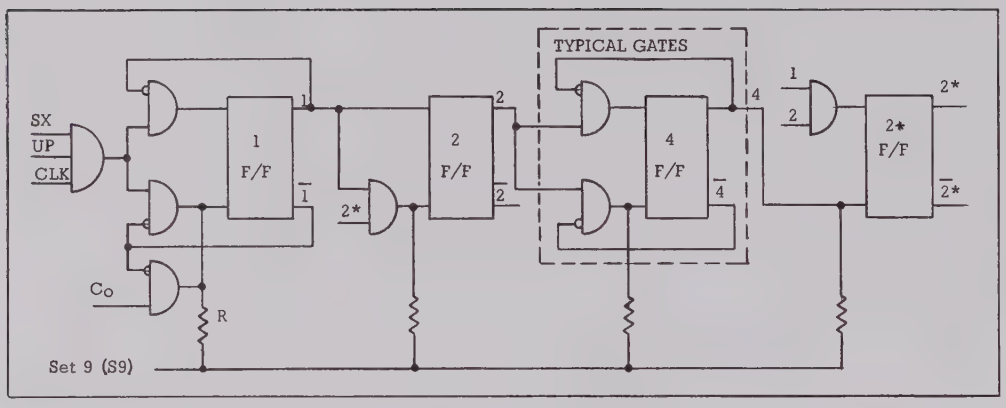


Figure 4.14 - Typical Decade Counter

Also included on the Decade circuit board is a Decoder that interprets the State of the flip-flops and produces the drive voltage for the numerical display and the BCD data to the Electrical Output accessory. There are five lines to the lamp, each representing a pair of numerals: 0 and 1, 2 and 3, 4 and 5, etc. Separate control lines determine whether the even or odd numeral is to be lit. During the digitizing cycle, a blanking signal inhibits both the odd and even enable lines.

4.3.3 Sequence Logic (Schematic 430348)

A counter on the Sequence Logic circuit board (Figure 4.15) generates the four sequence states — or periods during which each Decade is reset to zero and then counted up. In addition, logic gates on the board determine when the sequence counter is turned on — and also detect the "overrange" condition where the input exceeds the four-digit capability of that range. Operation of the Sequence Logic is described in the following paragraphs; in the first case, it is assumed that the input does not require the overflow function.

Initially, each Decade is set to nine, the Overflow flip-flop (on Control Logic board) is off, and each flip-flop in the sequence counter is off. In this assumed case, the value represented by the Decade setting of 9999 is greater than the input signal, therefore the Trigger flip-flop is not turned on and $\overline{UP}$ is "true." $\overline{UP}$ enables an "and" gate which causes the S1 (sequence state 1) flip-flop to be set. Other inputs to the "and" gate are the clock, Start/Stop, and the "false" side of the sequence counter flip-flops to assure that S1 is not set at any time other than at the start of a conversion.

As S1 goes "true," $\overline{S1}$ goes "false." The negative-going edge of $\overline{S1}$ resets the 1K Decade to zero (as explained under "Decades") and S1 enables the input gate to allow the Decade to start counting. The 1K Decade counts up until $\overline{UP}$ is received.

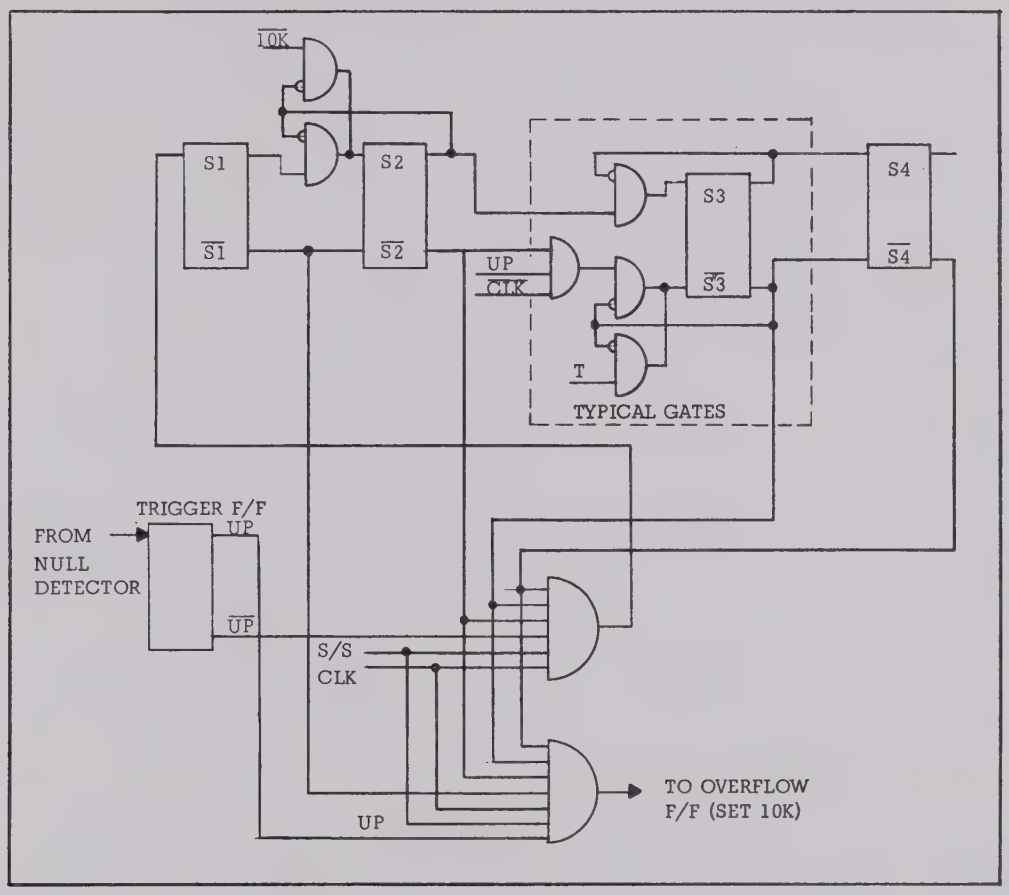


Figure 4.15 - Sequence Logic

$\overline{UP}$ resets the S1 flip-flop in the sequence counter. On the negative-going edge of S1, flip-flop S2 is set. The negative-going edge of $\overline{S2}$ resets the 100 Decade to zero. S2 enables the input gate of the 100 Decade and it begins counting.

The Sequence counter advances to S3 on the next $\overline{UP}$ and the 10 Decade count operation is performed. Then S4 controls the counting of the 1 Decade. The 10 and 1 Decades are set to zero by S2 and S3 rather than $\overline{S3}$ and $\overline{S4}$ since their negative-going edges occur at the same time; this eliminates the need of bringing out two extra leads from the board. The negative-going edge of S4 resets the Start/Stop flip-flop.

The function of each sequence state can be summarized as follows:

$\overline{S1}$ resets 1K Decade to zero (on negative-going edge);
S1 enables 1K Decade count-up;
$\overline{S2}$ resets 100 Decade to zero (on negative-going edge);
S2 enables 100 Decade count-up, and
resets 10 Decade to zero (on negative-going edge);
S3 enables 10 Decade count-up, and
resets 1 Decade to zero (on negative-going edge);
S4 enables 1 Decade count-up, and
resets start/stop flip-flop (on negative-going edge).

The overrange condition exists when, after the Decades are initially set to 9999, an UP is received. This indicates that the value represented by the state of the Decades is full-scale but still less than the input signal. This condition is detected by an "and" gate on the Sequence Logic board which receives the UP signal along with the clock, Start/Stop, and the "not" outputs of the sequence counter flip-flops. When UP enables this gate, a signal (Set 10K) is sent to the Control Logic board where it sets the overflow flip-flop. The overrange bit has a logical weight of 10,000. If the overrange bit is "true," the readout is 10XXX. For reasons of linearity and accuracy, the analog weight of the resistor associated with this bit is 1000. This requires that the 1K decade be set to 9; this results in a total weight of 9 + 1 or 10. The readout does not indicate 19999, but the true analog weight of 10999.

If, after the overrange bit is set, the new comparison at the Null Detector results in an $\overline{UP}$, this indicates that the input is some value between 9999 and 10999. The negative-going edge of $\overline{10K}$ places the instrument into sequence state 3 (see Figure 4.15) and the conversion proceeds as described before, but with the 1K position remaining at 9 and the 100 Decade the first Decade "dropped."

If, after the overflow bit is set, an $\overline{UP}$ is received — indicating that 10999 is still less than the input, a digitizing cycle is performed and the unit is made to up-range (if instrument equipped for auto range). If no higher range is available, the overrange indication of 10999 is displayed (printed) to indicate an excessive input.

4.3.4 Control Logic (Schematic 430349)

A logic diagram of the Control Logic is shown in Figure 4.16. The conversion operation begins when the Start/Stop flip-flop is set. Start/Stop is set either automatically, by the Display Rate circuit, or by an external command.

The Display Rate circuit is an oscillator which delivers a pulse every 250 milliseconds when the READ/HOLD switch is in the READ position. The oscillator output is inverted and applied to an "and" gate. The gate is inhibited by Ground

Hold when the READ/HOLD switch is in HOLD — or by Accessory Hold if the line is at ground level. The Start/Stop flip-flop is set on the negative-going edge of the Display Rate signal. Start/Stop is also set when an external command is received through the programming input or by Accessory Command.

As Start/Stop (S/S) is set, the negative-going edge of $\overline{S/S}$ sets the Reset flip-flop. $\overline{RESET}$ is applied through an inverter to the Decades as S9 (Set 9). It sets the Decades to 9999 and resets the Overflow flip-flop to zero. The Reset flip-flop is turned off by the next $\overline{CLOCK}$.

The "true" output of the Start/Stop flip-flop is applied to an inverter. The inverter output is the blanking level which biases off the display lamps during the digitizing process. At the end of a conversion, Start/Stop is turned off by S4 (negative-going). This releases the blanking signal and, at that time, the state of the Decades is displayed.

The Overflow flip-flop is set by the Set 10K signal from the Sequence Logic board. Its output operates a corresponding DAC switch, in the Null Detector, representing a "1" digit in the 10K position. This feature allows an overrange voltage to be measured and displayed.

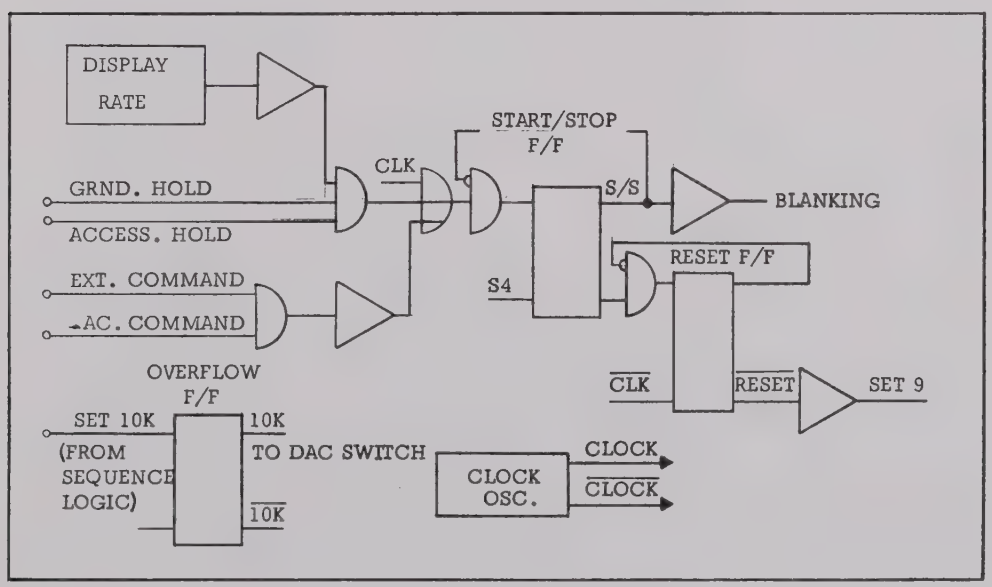


Figure 4.16 - Control Logic

4.3.5 Reference And Buffer Amplifier (Schematic 430350)

The Reference and Buffer Amplifier board serves two functions: it produces a precise 10-volt internal-reference output for absolute measurements, and it serves as a high input impedance, low-output impedance, unity-gain, buffer amplifier for external reference voltages used in ratio measurements. A relay on the board (K1) switches the circuit from internal reference to external buffer when energized by the RATIO line from the FUNCTION switch. The internal reference circuit is based on the use of an aged Zener diode. Figure 4.17 shows the Reference and Buffer Amplifier board connected to the Internal Reference circuit. The Internal Reference is a divider network consisting of a fixed resistor, a potentiometer, and a Zener diode. The drive current for the Zener comes from the output of the Reference Buffer itself. Through careful selection of components and a balancing of the various resistances in the feedback network, an essentially zero temperature coefficient is achieved within the operating range of the instrument.

4.3.6 Display (Schematic 430301)

The Display board provides a mechanical assembly for the digital display tubes and carries the drive circuits for the neons that indicate decimal point, polarity, function, and range.

Section 5

Calibration

5.1 SCOPE OF CALIBRATION

The field calibration of the Model 5400 is designed to keep the instrument operating within its specifications for indefinite periods of time. The procedures do not include the more detailed calibrations performed at the factory or following major repairs.

Equipment required for the field calibration of the Model 5400 is limited to precision DC and AC voltage sources and a set of standard resistors.

All adjustments are made on components located in the Module 020-030 drawer. Access to the components is from the top, requiring that the top cover of the instrument be removed. The AC and ohms adjustments are on the sides of their respective accessory boards, requiring an extender board for the calibration of these two functions.

Figure 5.1 illustrates all of the calibration points involved in the field calibration of the Model 5400.

5.2 ZERO CALIBRATION

Switch Function Control to millivolt and range to 100.

Short input leads.

Adjust Zero Control (through front panel hole) until Model 5400 display reads 000.00.

5.3 MINUS AND PLUS POLARITY GAIN

Switch Function Control to DC and range to 10.

Connect input leads to known negative voltage near -10 volts.

Adjust Minus Polarity Gain adjustment on Isolator Board until Model 5400 display reads value of known voltage.

Reverse polarity of input.

Adjust Plus Polarity Gain adjustment on Auto Polarity board until Model 5400 display reads value of known voltage.

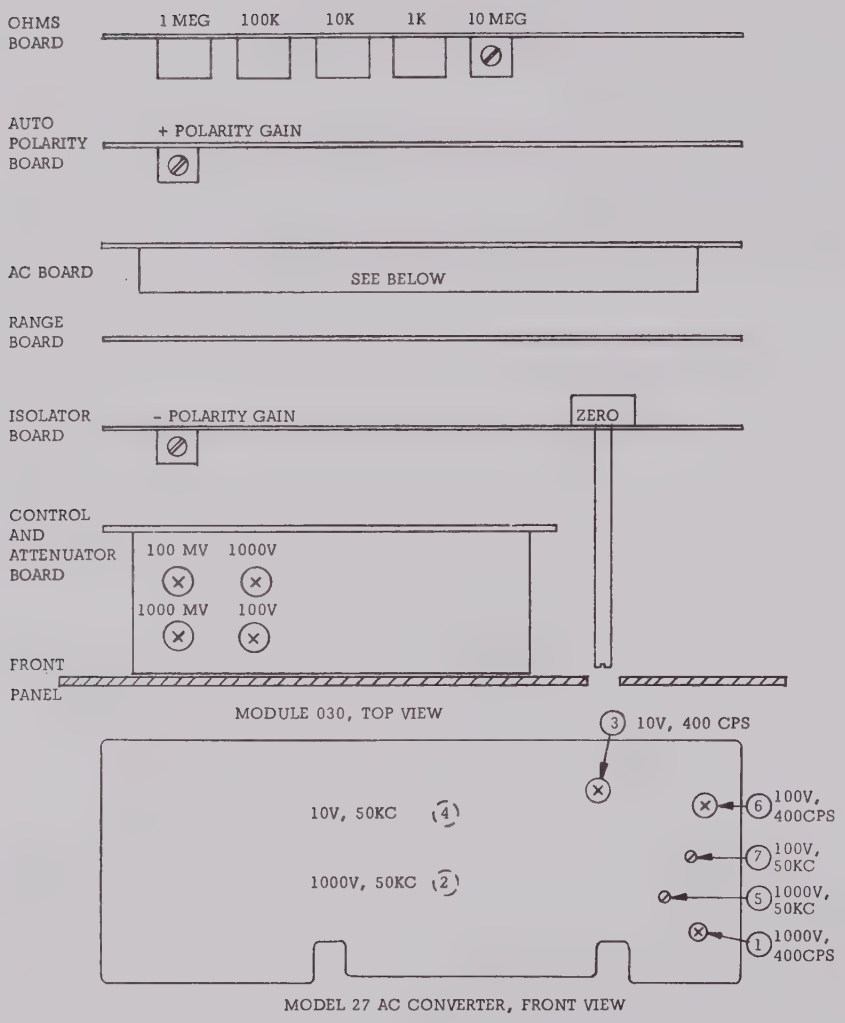


Figure 5.1 - Calibration Points - Model 5400/020-030

5.4 RANGE CALIBRATION - VOLTS

Switch range to 100.

Connect input leads to ±100 volt source.

Adjust 100 volt range adjustment on Control board until Model 5400 display reads value of known voltage.

Switch range to 1000 and repeat first two steps above with ±1000 volt source and 1000 volt range adjustment.

5.5 RANGE CALIBRATION - MILLIVOLTS

Switch Function Control to millivolts.

Short input leads and check that instrument is still zeroed.

Repeat all of steps in 5.4 using ±100 mV and ±1000 mV sources and adjusting the 100 mV and 1000 mV adjustments on Control board.

5.6 AC CALIBRATION - VOLTS

Switch Function Control to AC and range to AUTO.

With AC board on extender, adjust capacitor (5) to middle of its span (see Figure 5.1).

Connect input leads to the following series of AC voltages and frequencies, adjusting the indicated adjustment until the Model 5400 displays the known voltage value:

Volts, RMS	Frequency	Adjustment (Figure 5.1)
125.00	400	(1)
125.00	50 kc	(2)
9.0000	400 Hz	(3)
9.0000	50 kc	(4)
125.00	50 kc	(5)
90.000	400 Hz	(6)
90.000	50 kc	(7)

When all adjustments are completed, check accuracy of ranges at 50 Hz, using voltage inputs of approximately 9.0, 90.0, and 125 volts.

5.7 KILOHM CALIBRATION (Model 5400/030 only)

Switch Function Control to Kilohms and Range Control to AUTO.

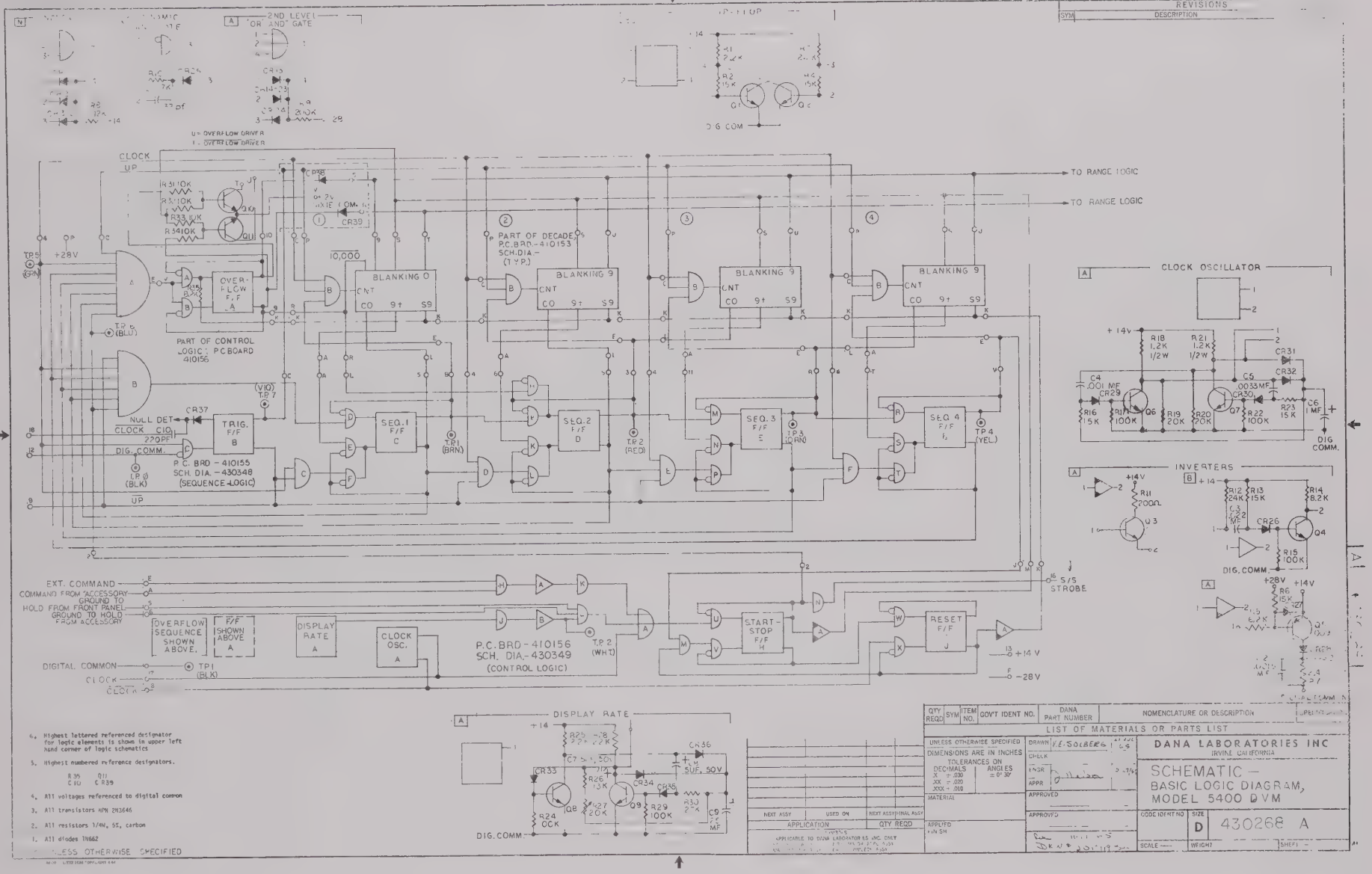
Connect input to a 10-megohm standard and adjust the 10-megohm range adjustment on Ohms board until the Model 5400 displays correct value.

Repeat with standard resistors near full scale of remaining four ranges, adjusting appropriate controls on Ohms board to produce correct values on Model 5400 display.

Section 6

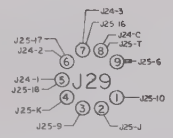
Drawings And Parts List

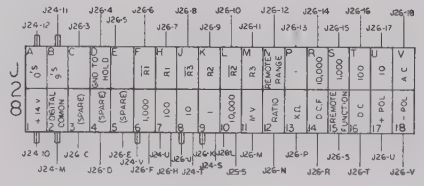
430268	Basic Logic Diagram
430311	Wiring Diagram - Interconnection
430362	Wiring Diagram - Model 5400 DVM, BCD Intraconnection
430309	Wiring Diagram - Intraconnection, Multimeter
400698	Attenuator and Control Assembly - Multimeter
430310	Schematic Control and Attenuator - Module 030
400703	PC Board Assembly - Attenuator
400704	PC Board Assembly - Switch Panel
400700	PC Board Assembly - Isolator
430305	Schematic - Isolator
400701	PC Board Assembly - Range Control
430307	Schematic - Range Control
400706	PC Board Assembly - AC Converter
430306	Schematic - AC Converter
400699	PC Board Assembly - Auto Polarity
430304	Schematic - Auto Polarity
400705	PC Board Assembly - Ohms Converter
430303	Schematic - Ohms Converter
430360	Wiring Diagram - Intraconnection, Multimeter
400858	Attenuator and Control Assembly - Multimeter
430310	Schematic Control and Attenuator - Module 030
400703	PC Board Assembly - Attenuator
400859	PC Board Assembly - Switch Panel
400700	PC Board Assembly - Isolator
430305	Schematic - Isolator
400701	PC Board Assembly - Range Control
430307	Schematic - Range Control
400706	PC Board Assembly - AC Converter
430306	Schematic - AC Converter
400699	PC Board Assembly - Auto Polarity
430304	Schematic - Auto Polarity
400691	PC Board Assembly - Display
430301	Schematic - Display
400862	PC Board Assembly - BCD Basic Decade
430363	Schematic - BCD Basic Decade
400843	PC Board Assembly - 4 Digit Null Detector
430351	Schematic - 4 Digit Null Detector
400688	PC Board Assembly - Sequence Logic
430348	Schematic - Model 5400 DVM Sequence Logic
400689	PC Board Assembly - Control Logic
430349	Schematic - Model 5400 DVM Control
400840	PC Board Assembly - Reference and Buffer Amplifier
430350	Schematic - Reference and Buffer Amplifier
400707	PC Board Assembly - Power Supply
430318	Schematic - Power Supply
400684	Rear Panel Assembly
400867	PC Board Assembly - Output Option 61
430387	Schematic - Printer, Program Basic
430388	Schematic - Printer, Program, 1-2-4-8 Negative True (Model 61)
400865	PC Board Assembly - Decade Matrix, Output Option 61
430365	Schematic - Decade Matrix, Output Option 61
430400	Wiring Diagram - Enclosure, 5400-1

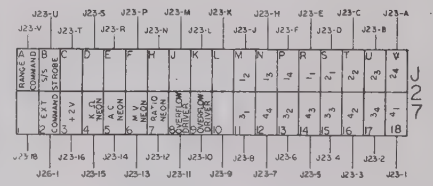

REVISIONS
SYM
DESCRIPTION
2ND LEVEL "OR AND" GATE
U = OVERFLOW DRIVER
I = OVERFLOW DRIVER
CLOCK UP
TO RANGE LOGIC
TO RANGE LOGIC
+28V
10,000
BLANKING 0
BLANKING 9
BLANKING 9
BLANKING 9
OVER-FLOW F/F A
PART OF CONTROL LOGIC P.C.BOARD 410156
PART OF DECADE P.C.BRD.-410153 SCH.DIA.- (TYP.)
NULL DET
CLOCK
DIG. COMM.
T.R.I. F/F B
P.C. BRD - 410155
SCH. DIA. - 430348
(SEQUENCE LOGIC)
SEQ. 1 F/F C
SEQ. 2 F/F D
SEQ. 3 F/F E
SEQ. 4 F/F F
EXT. COMMAND
COMMAND FROM ACCESSORY
GROUND TO HOLD FROM FRONT PANEL
GROUND TO HOLD FROM ACCESSORY
OVERFLOW SEQUENCE SHOWN ABOVE.
F/F SHOWN ABOVE. A
DISPLAY RATE A
CLOCK OSC. A
P.C.BRD-410156
SCH. DIA.-430349
(CONTROL LOGIC)
START-STOP F/F H
RESET F/F J
S/S STROBE
DIGITAL COMMON
CLOCK
CLOCK
+14 V
-28V
CLOCK OSCILLATOR
INVERTERS
DIG. COMM.
DISPLAY RATE
DIG. COMM.
4. Highest lettered referenced designator for logic elements is shown in upper left hand corner of logic schematics
5. Highest numbered reference designators.
R35 Q11
C10 CR39
4. All voltages referenced to digital common
3. All transistors NPN 2N3646
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662
UNLESS OTHERWISE SPECIFIED
QTY REQD
SYM
ITEM NO.
GOVT IDENT NO.
DANA PART NUMBER
NOMENCLATURE OR DESCRIPTION
LIST OF MATERIALS OR PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030 XX ± .020 XXX ± .010
ANGLES ± 0° 30'
MATERIAL
DRAWN V.E. SOLBERG
CHECK
ENGR
APPR
APPROVED
APPROVED
DANA LABORATORIES INC
IRVINE CALIFORNIA
SCHEMATIC — BASIC LOGIC DIAGRAM, MODEL 5400 DVM
CODE IDENT NO
SIZE D
430268 A
SCALE
WEIGHT
SHEET
NEXT ASSY
USED ON
NEXT ASSY FINAL ASSY
APPLICATION
QTY REQD
APPLIED P.O. NO.

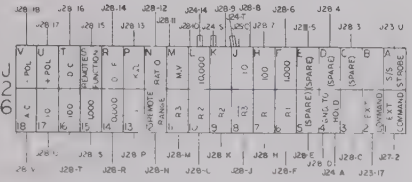
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

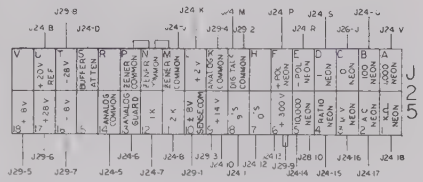
J29 PIN FUNCTIONS	
P/N	FUNCTION
1	+15 V SENSE COM
2	DIGITAL COMMON
3	+ 14 V
4	ANALOG COMMON
5	+ 18 V
6	+ 28 V
7	- 8 V
8	- 28 V
9	+ 300 V

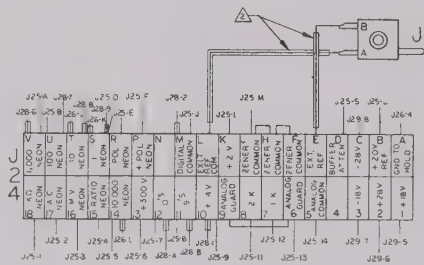


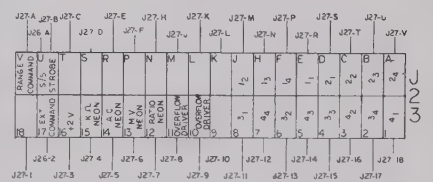












⚠1 LEADS INDICATED THUS: CONSIST PARTIALLY OF 22 GA. TINNED BUS WIRE (P/N 500004) INSULATED WITH 20 GA. TEFLON SLEEVING (P/N 501376)

⚠2 INDICATED CONNECTIONS CONSIST OF 22 GA. TINNED BUS WIRE (P/N 500004) INSULATED WITH 20 GA. TEFLON SLEEVING (P/N 501376).

1 CONNECTORS SHOWN AS VIEWED FROM REAR OF INSTRUMENT; THUS J23, J24, J25 & J26 ARE ON FAR SIDE OF INTERCONNECTION BOARD, J27, J28 & J29 ARE ON NEAR SIDE.

NOTES. UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO.

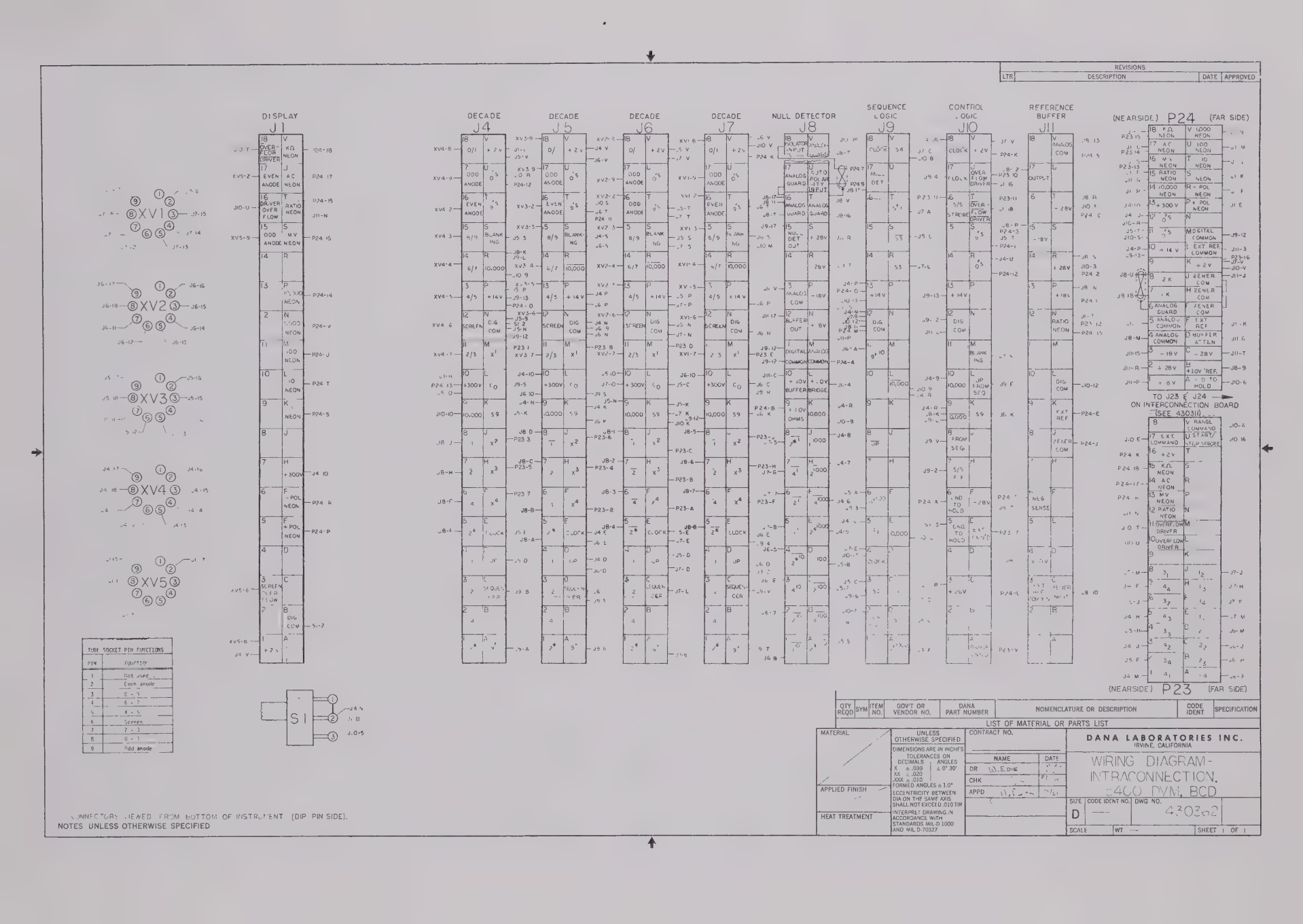
NAME	DATE
DR W. Eome	OCT 1962
CHK	0 OCT 1962
APPD	1965

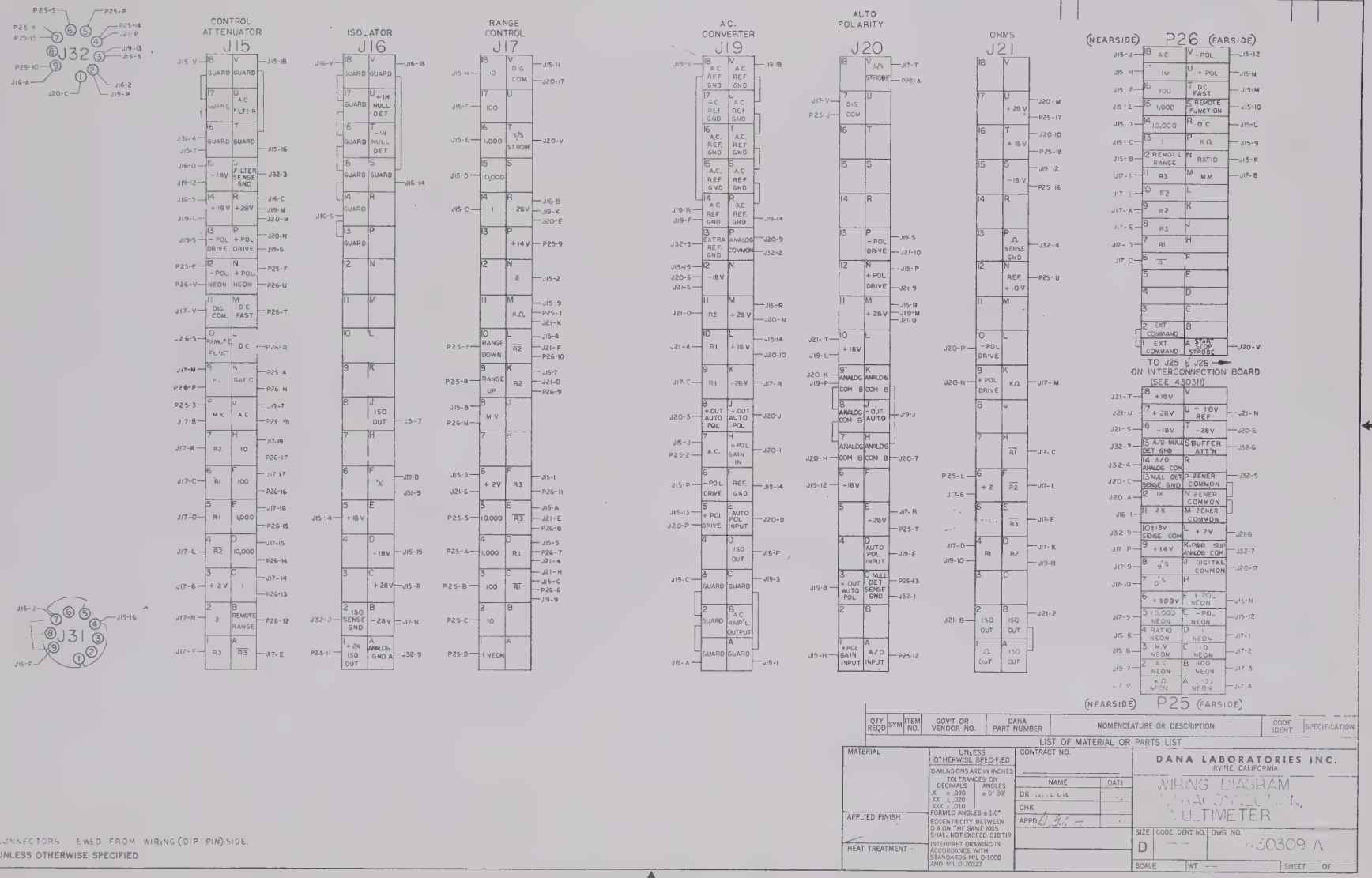
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM - INTERCONNECTION

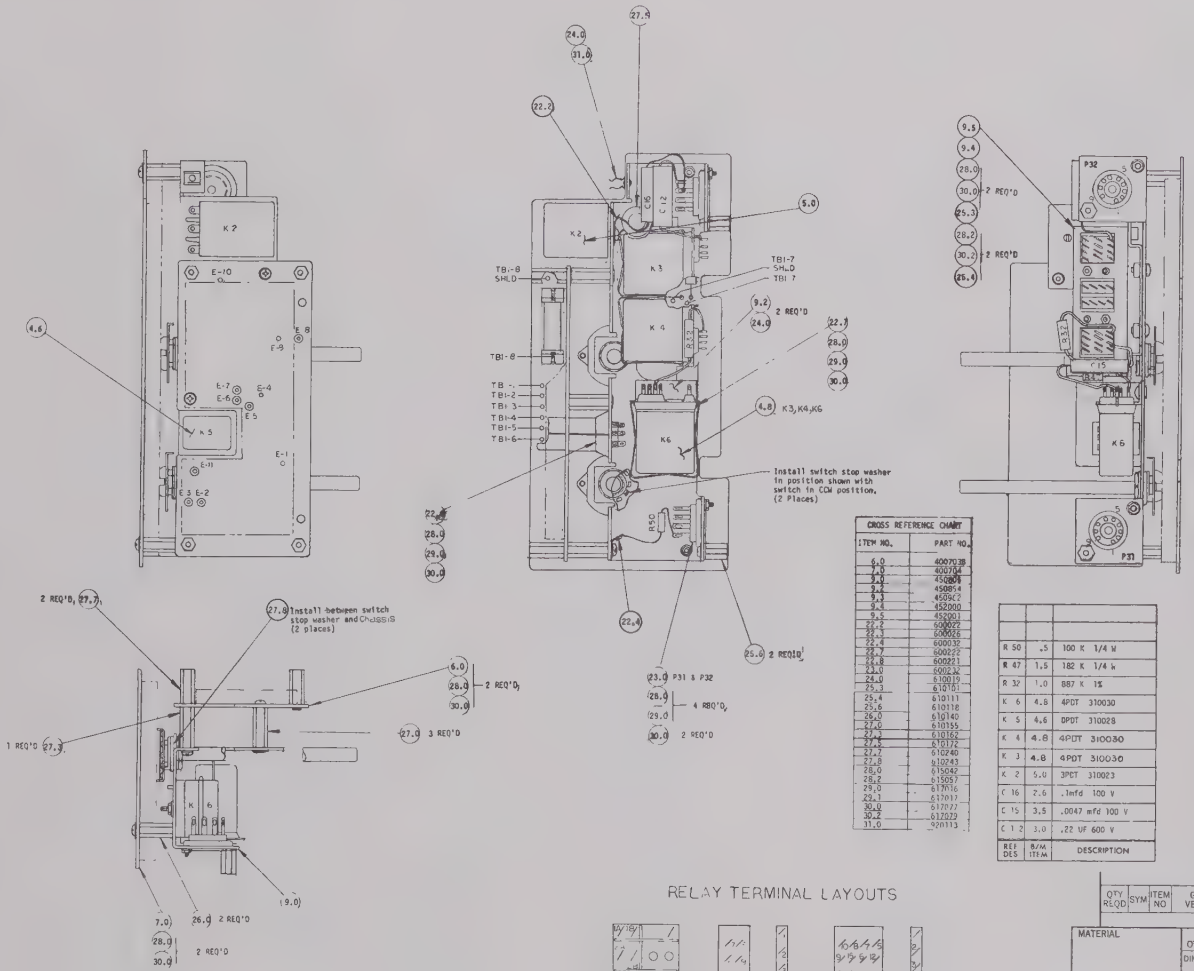
SIZE D | CODE IDENT NO | DWG NO. 430311 B

SCALE — | WT — | SHEET 1 OF 1


REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
DISPLAY J1
DECADE J4
DECADE J5
DECADE J6
DECADE J7
NULL DETECTOR J8
SEQUENCE LOGIC J9
CONTROL LOGIC J10
REFERENCE BUFFER J11
(NEARSIDE) P24 (FAR SIDE)
(NEARSIDE) P23 (FAR SIDE)
TO J23 & J24 ON INTERCONNECTION BOARD (SEE 430311)
XV1
XV2
XV3
XV4
XV5
S1
TUBE SOCKET PIN FUNCTIONS
PIN | FUNCTION
1 | Not used
2 | Even anode
3 | 8 - 9
4 | 6 - 7
5 | 4 - 5
6 | Screen
7 | 2 - 3
8 | 0 - 1
9 | Odd anode
CONNECTORS VIEWED FROM BOTTOM OF INSTRUMENT (DIP PIN SIDE).
NOTES UNLESS OTHERWISE SPECIFIED
QTY REQD | SYM | ITEM NO. | GOVT OR VENDOR NO. | DANA PART NUMBER | NOMENCLATURE OR DESCRIPTION | CODE IDENT | SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ±.030 XX ±.020 XXX ±.010 | ANGLES ±0° 30'
FORMED ANGLES ±1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327
CONTRACT NO.
NAME | DATE
DR W.E.DYE
CHK
APPD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
WIRING DIAGRAM - INTRACONNECTION, 5400 DVM, BCD
SIZE D | CODE IDENT NO. ---- | DWG NO. 430302
SCALE | WT --- | SHEET 1 OF 1


J32
J31
CONTROL ATTENUATOR J15
ISOLATOR J16
RANGE CONTROL J17
A.C. CONVERTER J19
AUTO POLARITY J20
OHMS J21
(NEARSIDE) P26 (FARSIDE)
TO J25 & J26 ON INTERCONNECTION BOARD (SEE 43031)
(NEARSIDE) P25 (FARSIDE)
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
QTY REQD
SYM
ITEM NO.
GOVT OR VENDOR NO.
DANA PART NUMBER
NOMENCLATURE OR DESCRIPTION
CODE IDENT
SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ANGLES
FORMED ANGLES ±1.0°
ECCENTRICITY BETWEEN D & ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D-70327
CONTRACT NO.
NAME
DATE
DR
CHK
APPD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
WIRING DIAGRAM
ULTIMETER
SIZE
CODE IDENT NO.
DWG NO.
D
30309 A
SCALE
WT
SHEET OF
CONNECTORS VIEWED FROM WIRING (DIP PIN) SIDE.
NOTES. UNLESS OTHERWISE SPECIFIED

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

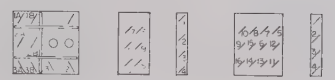


CROSS REFERENCE CHART	
ITEM NO.	PART NO.
6.0	400703B
7.0	400704
8.0	450804
9.2	450814
9.4	450962
9.5	452000
22.2	452001
22.3	600022
22.4	600026
22.6	600032
22.7	600222
22.8	600221
23.0	600234
24.0	610019
25.3	610161
25.4	610111
25.6	610118
26.0	610140
27.0	610155
27.2	610162
27.5	610172
27.7	610240
27.8	610243
28.0	615042
28.2	615057
29.0	617016
29.1	617017
30.0	617027
30.2	617029
31.0	920113

R 50	.5	100 K 1/4 W	
R 47	1.5	182 K 1/4 W	
R 32	1.0	887 K 1%	
K 6	4.8	4PDT 310030	
K 5	4.6	DPDT 310028	
K 4	4.8	4PDT 310030	
K 3	4.8	4PDT 310030	
K 2	5.0	3PDT 310023	
C 16	2.6	.1mfd 100 V	
C 15	3.5	.0047 mfd 100 V	
C 12	3.0	.22 UF 600 V	
REF DES	B/M ITEM	DESCRIPTION	

FROM	TO	CONDUCTOR USED; COLOR	B/M ITEM NO.	WIRE LENGTH	NOTES	LINE
TB1-1	K2-B	9-1-2	16.0		VIA GROMMET (ITEM 27.5)	1
TB1-2	K4-4	9-2	20.0			2
TB1-3	K3-1	9-3	20.5			3
TB1-4	K5-4	9-1-5	17.0			4
TB1-5	K6-1	5	14.5			5
TB1-6	K6-4	9-1-6	17.5			6
TB1-7	K3-16	RG174/U	12.0			
Shld to TB1-7 Shld	Shld not conn.	0	12.8 ± 9.6		TUBING AS REQ'D	7
TB1-8	K6-9	RG174/U	12.0			
Shld to TB1-8 Shld	Shld not conn.	0	12.8 ± 9.6		VIA GROMMET (ITEM 27.5) TUBING AS REQUIRED	8
E-1	K5-10	8	15.5			9
E-2	K5-5	9-1	17.0			10
E-3	K5-7	0	18.8			11
E-4	K6-14	7-1-1	19.5			12
E-5	K5-8	9-1-3	16.5			13
E-6	K4-16	2-6-6	13.0			14
E-7	K4-13	9-1-8	18.5			15
E-8	K6-11	9-1-7	18.0			16
E-9	P31-5	2-1-5	14.0			17
E-10	K2-A	2-1-5	14.0			18
E-11	P31-7	7-2-8	15.0			19
K2-A	K3-4	9-1-3	16.5		VIA GROMMET (ITEM 27.5)	20
K2-3A	P32-1	9-1-2	16.0			21
K2-1	Lug(Item no. 22.3)	RG174/U	12.0			22
Shld to K2-3	Shld to Lug(Item no. 22.1)	0	12.8 ± 9.6		TUBING AS REQ'D	
K2-B	P31-6	RG174/U	12.0			23
Shld not conn.	Shld to P31-7	0	12.8 ± 9.6		TUBING AS REQ'D	
K2-3	P32-1	9-1-5	17.0		VIA GROMMET (ITEM 27.5)	24
K3-4	K4-1	9-1	19.0			25
K3-14	K6-15	Sleeved Buss Wire	10.0 & 11.0			26
K3-11	K4-9	Sleeved Buss Wire	10.0 & 11.0			27
K3-8	K6-12	Sleeved Buss Wire	10.0 & 11.0			28
K3-13	K5-5	RG174/U	12.0			29
Shld not conn.	Shld to P32-8	0	12.8 ± 9.6		TUBING AS REQUIRED	
K3-10	P32-8	C12, .22uF/ 600V	3.0 & 11.0		Leads Sleeved As Req'd	30
K3-15	K6-13	RG174/U	12.0			31
Shld not conn.	Shld to P31-6	0	12.8 ± 9.6		TUBING AS REQUIRED	
K3-12	P31-3	RG174/U	12.0			32
Shld not conn.	Shld to P31-4	0	12.8 ± 9.6		TUBING AS REQUIRED	
K3-9	Lug(Item no. 22.3)	RG174/U	12.0			33
Shld to R32-9	Shld to Lug(Item no. 22.3)	0	12.8 ± 9.6		TUBING AS REQUIRED	
K4-1	K6-4	2-2-4	12.5			34
K4-14	K6-10	R47, 182K R15, .0047UF/100V	1.5 & 11.0 3.5 & 11.0		Resistor wired in parallel with capacitor; Leads sleeved as req'd.	35
K4-11	K6-7	R32, 887K .1%	1.0 & 11.0		Leads Sleeved As Req'd	36
K4-8	P31-9	0-9	12.9			37
K5-1	K 6 - 4	9	22.1			38
K5-9 Shld to P31-4	K6-8 Shld not conn.	RG174/U 0	12.0 12.8 ± 9.6		TUBING AS REQUIRED	39
K5-1	K6-1	9	12.8			40
K6-12	P31-2	RG174/U	12.0			41
Shld not conn.	Shld to P31-1	0	12.8 ± 9.6		TUBING AS REQUIRED	
K6-15	P32-5	9	20.1			42
K6-8	K6-11	Sleeved Buss Wire	10.0 & 11.0			43
K6-5	K6-10	Sleeved Buss Wire	10.0 & 11.0			44
P31-1	Lug(Item no. 22.4)	R50, 100K, 1/4 W C16, .1 UF/100V	.5 & 11.0		Leads Sleeved As Req'd	45
P32-3	Lug(Item no. 22.2)	C16, .1 UF/100V	2.6 & 11.0		Leads Sleeved As Req'd	46

RELAY TERMINAL LAYOUTS

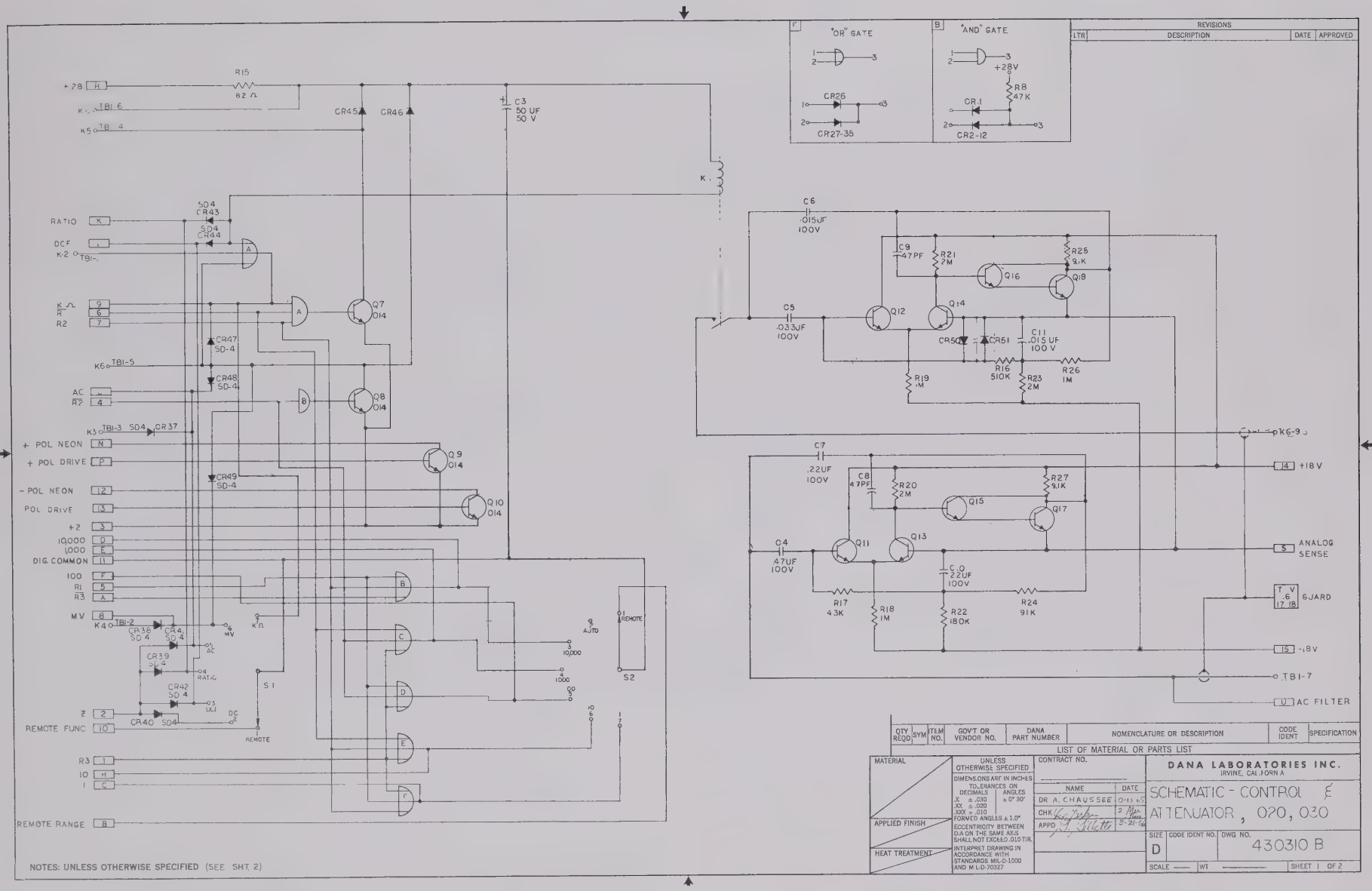


NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH	DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'; FORMED ANGLES ± 1.0°; ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.	NAME / DATE: DR, CHK, APPD	TEST [illegible]
HEAT TREATMENT	INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL-D 70327		SIZE D; CODE IDENT NO; DWG NO; SCALE; WT; SHEET OF 1



QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND M L-D-70327

CONTRACT NO.

	NAME	DATE
DR	A. CHAUSSEE	2-15-62
CHK		2-21-62
APPD		3-21-62

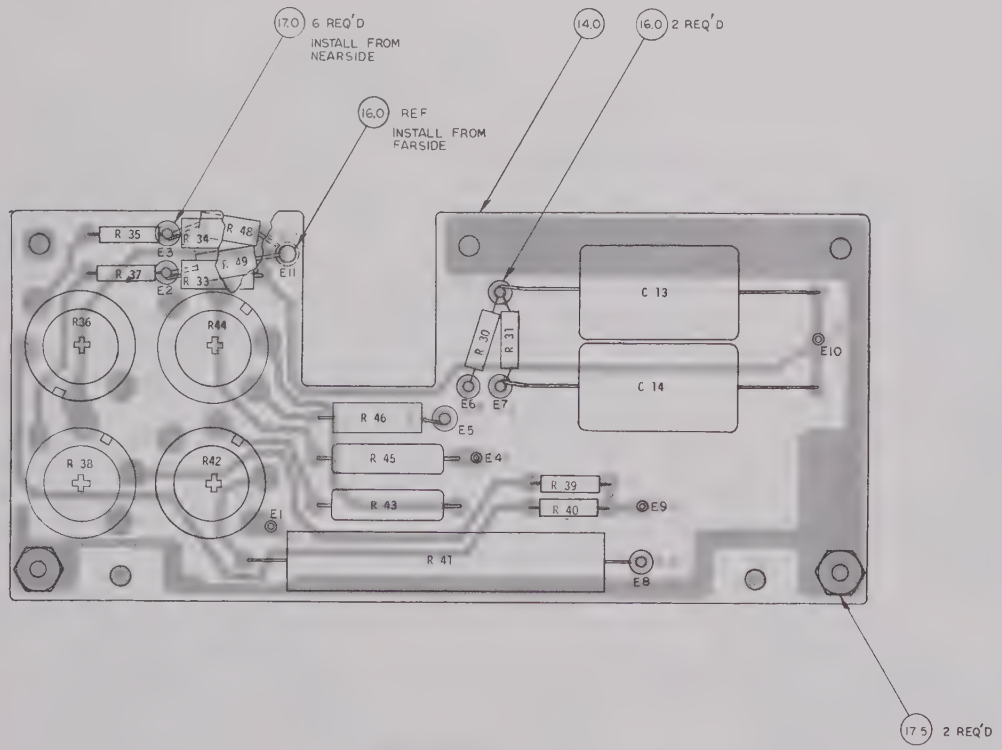
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - CONTROL & ATTENUATOR, 020, 030

SIZE	CODE IDENT NO.	DWG NO.
D		430310 B

SCALE — WT — SHEET 1 OF 2

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 49	8.0	10 K .05%
R 48	8.0	10 K .05%
R 46	5.0	806 K 1% (RN65)
R 45	6.0	99.75 K 1/4W (SET)
R 44	12.3	500 ohms (POT)
R 43	6.0	897.2 K, 1/4W (SET)
R 42	12.0	5 K (POT)
R 41	6.0	8.997 Meg (SET)
R 40	2.0	150 K
R 39	1.0	15 K
R 38	12.0	5 K (POT)
R 37	3.[illegible]	820 K
R 36	12.0	5 K (POT)
R 35	4.0	82 K
R 34	10.0	100.83 ohms, .05% WW
R 33	10.4	1.1111 K, .05% WW
R 31	4.5	4.99 K RN60D
R 30	4.5	4.99 K RN60D
C 14	13.0	4.7 MFD 60V
C 13	13.0	4.7 MFD 60V

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
14.0	410171
16.0	600030
17.0	600243
17.5	610140

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
LIST OF MATERIALS OR PARTS LIST						

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA..... SUB—ASSY MRA.... MAJOR REPL ASSY
MA..... MODULE ASSY CA..... COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN	W. Edie	18 Nov. 1965
CHECK	WMS Curdy	18 Nov 65
ENGR		12/13/65
APPR		

APPROVED

APPROVED
Pat 12-13-65
DR# 217

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y- ATTENUATOR

CODE IDENT NO.	SIZE		
—	C	400703	B
SCALE 2/1	WEIGHT —	SHEET 1 OF 1	

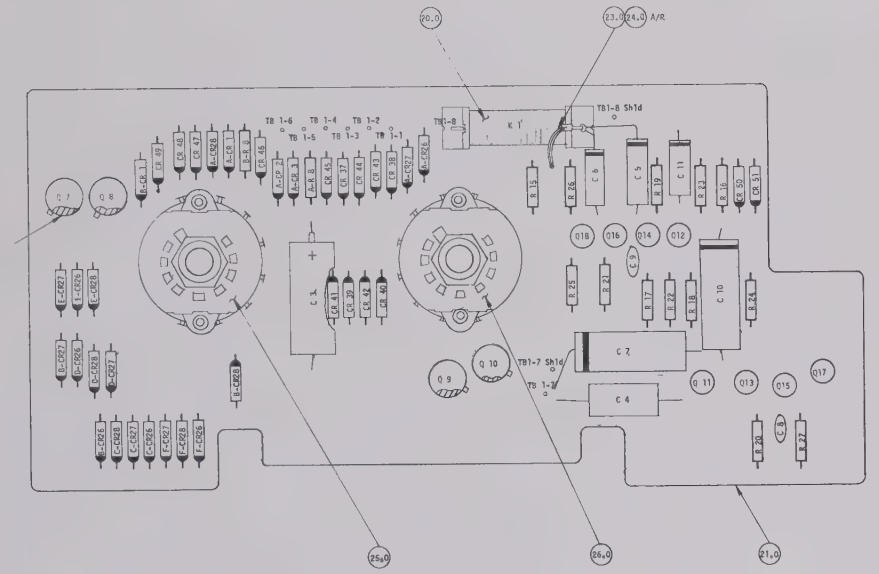
1. Resistors to be 1/4W, ± 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED

586-00 LIETZ 1030 TOPFLIGHT 4-64

B| 400703 |

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER E.O. # 979	15 FEB 66	
B	RELEASED TO PRODUCTION PILOT	15 FEB 66	



CR45	19.0	1N662
CR44	18.0	SD 4
Thru		
CR37	18.0	SD 4
CR28	19.0	1N662
A-CR28	18.0	SD 4
CR27	19.0	1N662
A-CR27	18.0	SD 4
CR26	19.0	1N662
A-CR26	18.0	SD 4
CR 4	19.0	1N662
CR 3	19.0	1N662
B-CR1	18.0	1N662
A-CR2	18.0	1N662
A-CR1	18.0	SD 4
C 11	13.0	.015 MFD
C 10	15.0	.22 MFD 100 V
C 9	10.0	47 pf DISC
C 8	10.0	47 pf DISC
C 7	15.0	.22 MFD 100 V
C 6	13.0	.015 MFD 100 V
C 5	14.0	.033 MFD 100 V
C 4	11.5	.47 MFD 100 V
C 3	11.5	50 MFD 50 V
REF DES	B/M ITEM	DESCRIPTION

Q 12	18.0	2N3565
Thru		
Q 11	16.0	2N3565
Q 10	15.7	014
Thru		
Q 7	15.7	014
R 27	8.0	9.1 K
R 26	1.0	1 Meg
R 25	8.0	9.1 K
R 24	9.0	91 K
R 23	4.0	2 Meg
R 22	3.0	180 K
R 21	4.0	2 Meg
R 20	4.0	2 Meg
R 19	1.0	1 Meg
R 18	1.0	1 Meg
R 17	5.0	43 K
R 16	6.0	510 K
R 15	7.0	82 ohms
R 8	5.5	47K
CR 51	19.0	1N662
CR 50	19.0	1N662
CR 49	18.0	SD 4
Thru		
CR 47	18.0	SD 4
CR 46	19.0	1N662
REF DES	B/M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
20.0	310013
21.0	410163
23.0	500204
24.0	501376
25.0	500218
26.0	500236
27.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

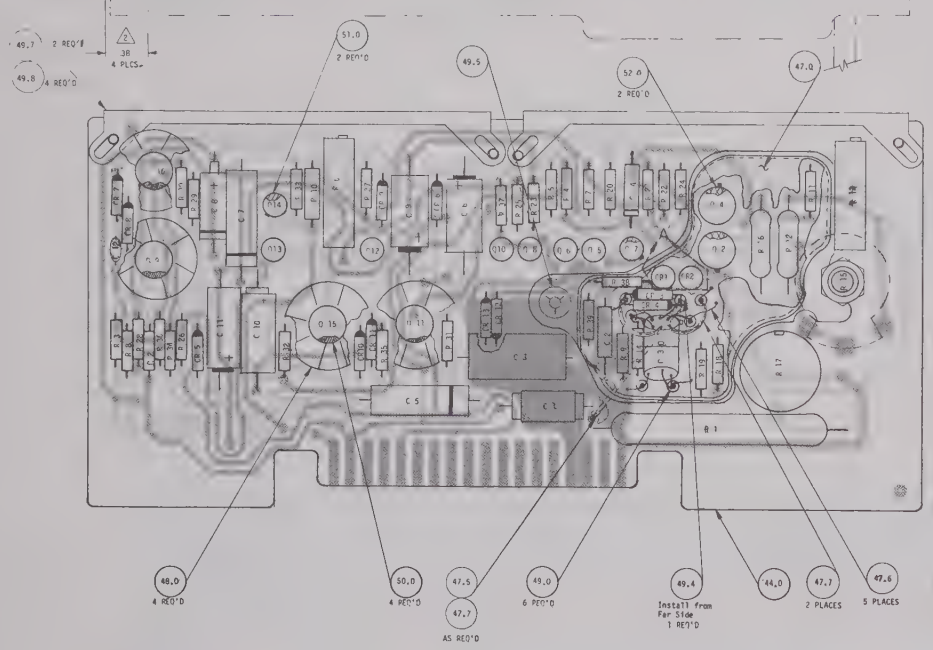
LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
	DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: ANGLES X ± .030 ± 0° 30' XX ± .020 XXX ± .010 FORMED ANGLES ± 1.0° CONCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL-D-70327	NAME / DATE: DR; CHK; APPD	P C BOARD ASS'Y SWITCH PANEL, 030
APPLIED FINISH			SIZE D; CODE IDENT NO.; DWG NO. 400704; B
HEAT TREATMENT			SCALE 2/1; WT; SHEET 1 OF

1. All resistors 1/4d, 5%, Carbon

NOTES UNLESS OTHERWISE SPECIFIED

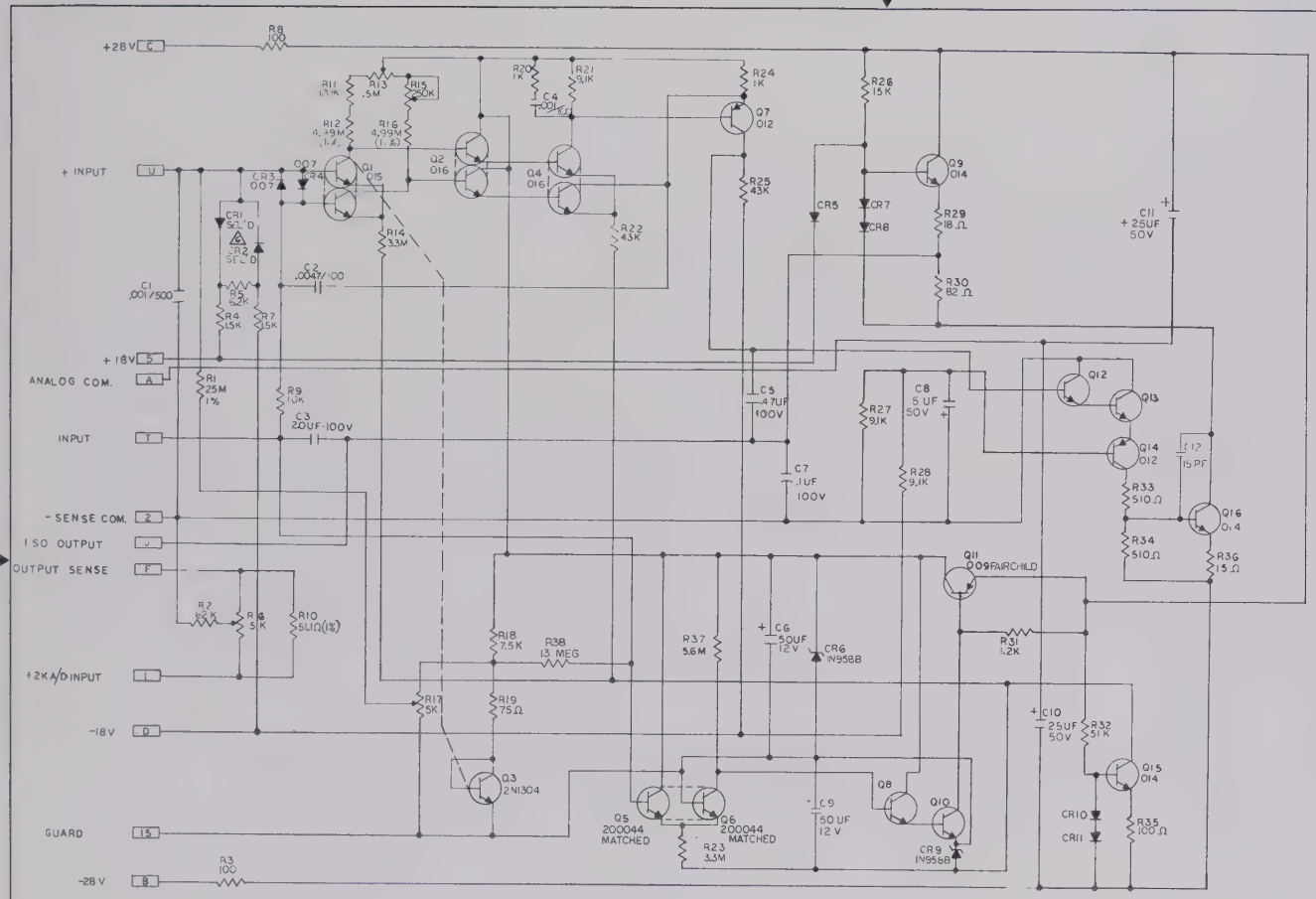
ISOLATOR 400700 SERIAL NO [illegible] DANA



REF DES	B/M ITEM	DESCRIPTION
P 1	22.0	25 Meg T T
CR 14	42.0	1N662
CR 12	42.0	1N662
CR 11	42.5	1N662
CR 10	42.0	1N662
CR 9	43.0	1N958B
CR 8	42.0	1N662
CR 7	42.0	1N662
CR 6	43.0	1N958B
CR 5	42.0	1N662
CR 4	42.5	007
CR 3	42.5	007
CR 2	39.5	200048
CR 1	39.5	200048
C 12	25.5	15 pf DISC
C 11	26.0	25 MFD 50 V
C 10	26.0	25 MFD 50 V
C 9	27.0	50 MFD 12/15 V
C 8	28.0	5 MFD 50 V
C 7	29.0	.1 MFD 100 V
C 6	27.0	50 MFD 12/15 V
C 5	29.0	.1 MFD 100 V
C 4	31.0	.001 MFD 100 V
C 3	30.0	2.0 MFD 100 V
C 2	32.0	.0047 MFD 100 V
C 1	29.1	.001 MFD 500 V

REF DES	B/M ITEM	DESCRIPTION
P 31	4.0	1.2 K
P 30	39.0	82 ohms
P 29	9.0	18 ohms
P 28	20.0	9.1 K
P 27	20.0	9.1 K
P 26	8.0	15 K
P 25	11.0	43 K
P 24	2.0	1 K
P 23	10.0	3.3 Meg
P 22	10.5	39 K
P 21	20.0	9.1 K
P 20	2.0	1 K
P 19	17.0	75 ohms
P 18	18.0	7.5 K
P 17	23.0	5 K POT
P 16	21.0	4.99 Meg 1%
P 15	24.0	250 K POT
R 14	10.0	3.3 Meg
R 13	25.0	500 K POT
R 12	21.0	4.99 Meg 1%
R 11	5.0	120 K
R 10	22.2	51.1 ohms 1%
P 9	9.5	2.4K
R 8	1.0	100 ohms
R 7	7.0	1.5 K
R 6	22.8	5 K POT
R 5	16.0	6.2 K
R 4	7.0	1.5 K
R 3	1.0	100 ohms
R 2	16.1	62 K

REF DES	B/M ITEM	DESCRIPTION



⚠ CR 1 & CR 2 are DANA P/N 20004B selected 2N1565.

5. Highest numbered reference designators:
   R38 Q16
   C12 CR11
4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: .X ± .030; .XX ± .010; .XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR		9-4-65
CHK		9-4-65
APPD	Jerry Gillette	9-16-65

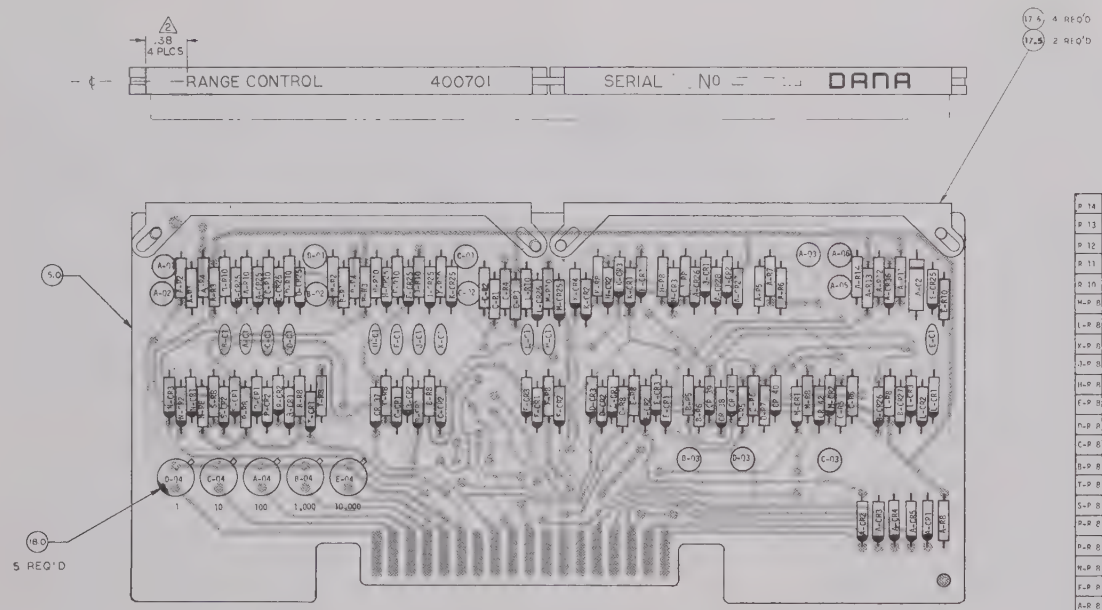
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
ISOLATOR

SIZE	CODE IDENT NO	DWG NO.	
D	—	430305	B

SCALE — WT — SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
P 14	7.0	15 K
P 13	8.0	8.2 K
P 12	8.0	8.2 K
P 11	4.0	24 K
P 10	5.0	27 K
W-P 8	8.0	8.2 K
L-P 8	8.0	8.2 K
K-P 8	8.0	8.2 K
J-P 8	8.0	8.2 K
H-P 8	8.0	8.2 K
E-P 8	7.0	5.1 K
N-P 8	7.0	5.1 K
C-P 8	1.0	12 K
B-P 8	1.0	12 K
T-P 8	4.0	24 K
S-P 8	4.0	24 K
P-P 8	4.0	24 K
R-P 8	4.0	24 K
M-P 8	4.0	24 K
F-P 8	4.0	24 K
A-P 8	4.0	24 K
P 7	1.0	200 K
P 6	2.0	15 K
P 5	8.0	8.2 K
P 4	2.0	15 K
P 3	3.5	2.2 K
P 2	2.0	15 K
P 1	3.5	2.2 K

REF DES	B/M ITEM	DESCRIPTION
CR42	14.0	1N662
CR41	14.0	1N662
CR40	14.0	1N662
CR39	14.0	1N662
CR38	13.0	SD 4
CR37	13.0	SD 4
CR36	14.0	1N662
CR25	14.0	1N662
K-CR4	13.0	1N662
J-CR4	13.0	SD 4
L-CR3	13.0	SD 4
J-CR3	13.0	SD 4
CR 3	14.0	1N662
M-CR2	13.0	SD 4
K-CR2	13.0	SD 4
L-CR2	13.0	SD 4
A-CR2	13.0	SD 4
CR 2	14.0	1N662
A-CR1	13.0	SD 4
CR 1	14.0	1N662
C 2	10.0	.0022 MFD, 100 V
E L 1	9.0	330 mH
C 1	9.5	100 pF

REF DES	B/M ITEM	DESCRIPTION
Q 4	11.0	2N3646
Q 5	11.0	2N3646
Q 1	10.8	914
Q 3	11.0	2N3646
Q 2	11.0	2N3646
Q 6	11.0	2N3646

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
15.0	410168A
17.5	610236
17.6	890237
18.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

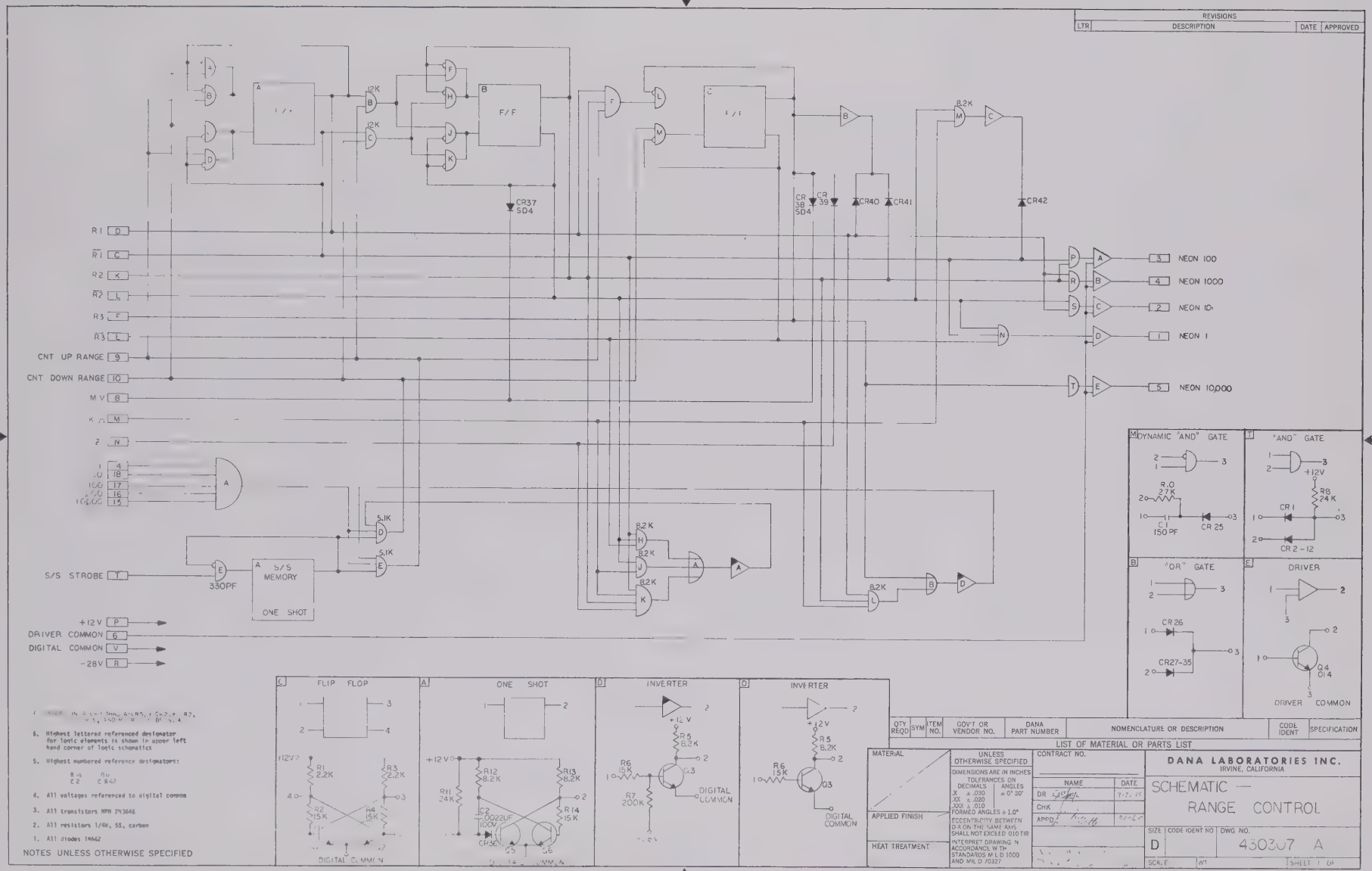
LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH	DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'; FORMED ANGLES ± 1.0°; ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327	NAME / DATE: DR 24 MAY 65; CHK 28 MAY 1965; APPD	P.C. BOARD ASSEMBLY- RANGE CONTROL
HEAT TREATMENT			SIZE D; CODE IDENT NO. —; DWG NO. 400701 C; SCALE 2/1; WT; SHEET 1 OF 1

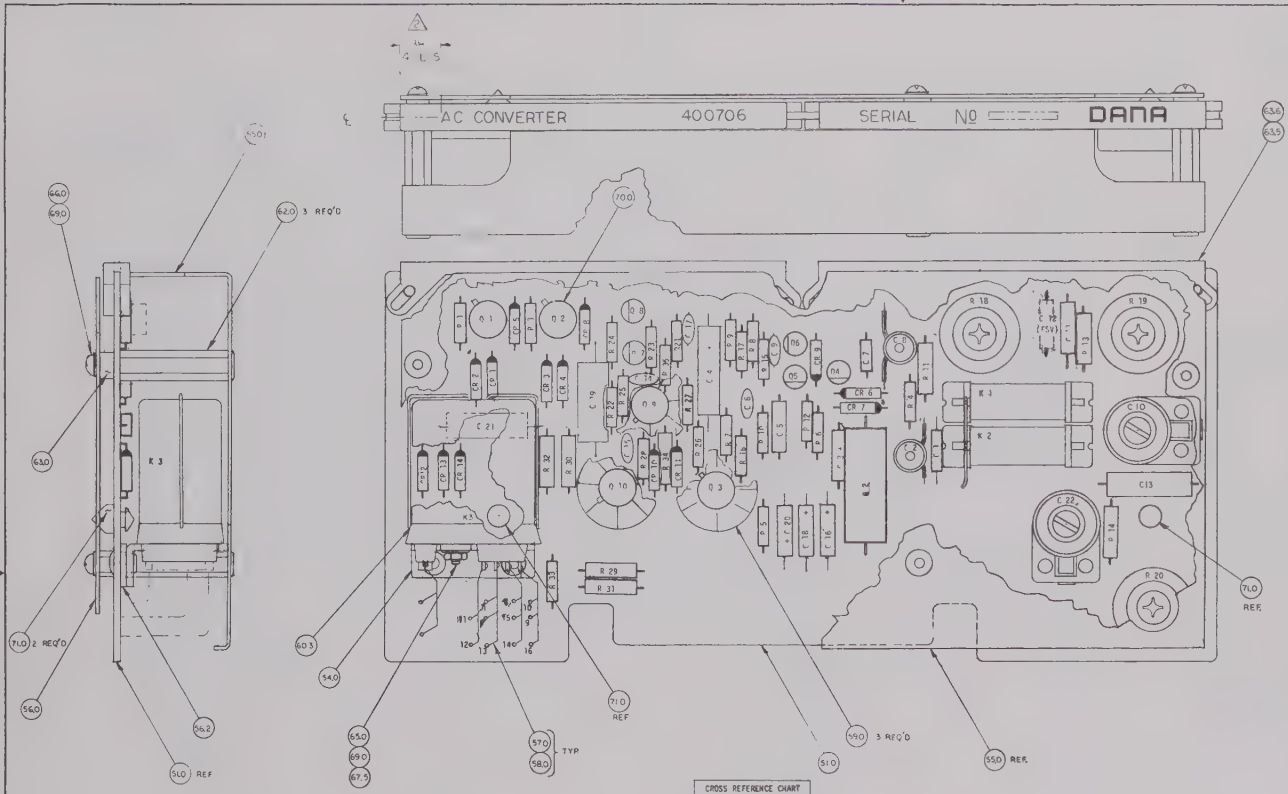
2 HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.

1 ALL RESISTORS 1/4 W, 5%, CARBON

NOTES: UNLESS OTHERWISE SPECIFIED


REVISIONS
LTR DESCRIPTION DATE APPROVED
F/F
F/F
F/F
CR37 SD4
CR 38 SD4
CR 39
CR40
CR41
CR42
12K
8.2K
R1
R1
R2
R2
R3
R3
CNT UP RANGE
CNT DOWN RANGE
M V
S/S STROBE
330PF
S/S MEMORY
ONE SHOT
5.1K
8.2K
+12V
DRIVER COMMON
DIGITAL COMMON
-28V
NEON 100
NEON 1000
NEON 10
NEON 1
NEON 10,000
DYNAMIC "AND" GATE
"AND" GATE
"OR" GATE
DRIVER
R.O 27K
C1 150 PF
CR 25
R8 24K
CR 1
CR 2-12
CR 26
CR27-35
Q4 014
DRIVER COMMON
FLIP FLOP
ONE SHOT
INVERTER
INVERTER
R1 2.2K
R2 15K
R3 2.2K
R4 15K
R11 24K
R12 8.2K
R13 8.2K
R14 15K
C2 .0022UF 100V
R5 8.2K
R6 15K
R7 200K
Q3
DIGITAL COMMON
NOTES UNLESS OTHERWISE SPECIFIED
6. Highest lettered referenced designator for logic elements is shown in upper left hand corner of logic schematics
5. Highest numbered reference designators:
4. All voltages referenced to digital common
3. All transistors NPN 2N3646
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662
QTY REQD
SYM
ITEM NO.
GOVT OR VENDOR NO.
DANA PART NUMBER
NOMENCLATURE OR DESCRIPTION
CODE IDENT
SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
X ±.030 ±0° 30'
XX ±.020
XXX ±.010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN O.A.ON THE SAME AXIS SHALL NOT EXCEED 010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS M.I.L.D.1000 AND MIL D 70327
CONTRACT NO.
NAME DATE
DR 7-7-67
CHK
APPD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC —
RANGE CONTROL
SIZE CODE IDENT NO DWG NO.
D 4303U7 A
SCALE WT SHEET 1 OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 30	25.0	270 K .1%
R 29	25.0	270 K .1%
R 28	13.0	39 ohm
R 27	18.0	91 ohm
R 26	2.0	10 K
R 25	13.0	4.3 K
R 24	10.0	33 ohm
R 23	17.0	750 ohm
R 22	10.0	33 ohm
R 21	5.0	15 K
R 20	27.0	50 ohm, CTS
R 19	28.0	500 ohm, CTS 10 turn
R 18	28.0	5 K, CTS
R 17	12.0	3.9 K
R 16	6.0	200 ohm
R 15	4.0	1.5 K
R 14	23.5	3.319 K, .25% MATCH SET
R 13	23.5	36.53 K, .25% MATCH SET
R 12	19.0	91 K
R 11	23.5	329 K, .25% MATCH SET
R 10	6.0	200 ohm
R 9	9.0	2.7 K
R 8	15.0	6.8 K
R 7	14.0	47 ohm
R 6	19.0	91 K
R 5	1.0	100 ohm
R 4	16.0	680 K
R 3	14.3	47 K
R 2	23.5	1 M, .1% MATCH SET
R 1	14.3	47 K

REF DES	B/M ITEM	DESCRIPTION
C 22	42.0	7-45 pf
C 21	37.0	.39 MFD 100V
C 20	32.0	6.8 MFD 35V
C 19	33.0	22 MFD 35 V
C 18	32.0	6.8 MFD 35V
C 17	29.0	22 pf
C 16	32.0	6.8 MFD 35V
C 15	31.0	470 pf
C 14	30.0	10 pf
C 13	42.6	3000 pf
C 12		25V (Normally) (not Used)
C 11	42.5	240 pf
C 10	42.0	7-45 pf
C 9	30.0	10 pf
C 8	40.0	1-5 mf
C 7	42.4	27 pf 5%
C 6	31.0	470 pf
C 5	32.0	6.8 MFD 35V
C 4	35.0	50 MFD 15V
C 3	34.0	1 MFD 35V
C 2	40.0	1-5 pf
C 1	41.0	6.8 pf, Glass
R 35	4.0	1.5 K
R 34	19.5	820 ohm 1/2 W
R 33	7.0	2 K
R 32	24.0	135 K, .1%
R 31	24.0	135 K, .1%

REF DES	B/M ITEM	DESCRIPTION
K 3	50.0	4 PDT
K 2	49.0	SPST
K 1	49.0	SPST
D 10	44.0	014
D 9	43.0	009
D 8	45.0	2N3565
D 7	45.0	2N3565
D 6	45.0	2N3565
D 5	45.0	2N3565
D 4	45.0	2N3565
D 3	44.0	014
D 2	44.0	014
D 1	44.0	014
CR14	46.0	CR 4
CR13	46.0	CR 4
CR12	46.0	CR 4
CR11	47.0	1N662
CR10	47.0	1N662
CR 9	48.0	1N961R
CR 8	47.0	1N662
CR 7		
CR 6		
CR 5		
CR 4	47.0	1N662
CR 3	47.0	1N662
CR 2	47.0	1N662
CR 1	47.0	1N662

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
51.0	410159C
54.0	450854
55.0	450960
56.0	450961
56.2	450963
57.0	500004
58.0	501376
59.0	600016
60.3	600222
62.0	610220
63.0	610221
63.5	610236
63.6	610237
65.0	615042
66.0	615044
67.5	617016
69.0	617077
70.0	920006
71.0	920033

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS / ANGLES
X ± .030 / ± 0° 30'
XX ± .020
XXX ± .010
FORMED ANGLES ± 1 0°
EXCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASSY-
AC CONVERTER

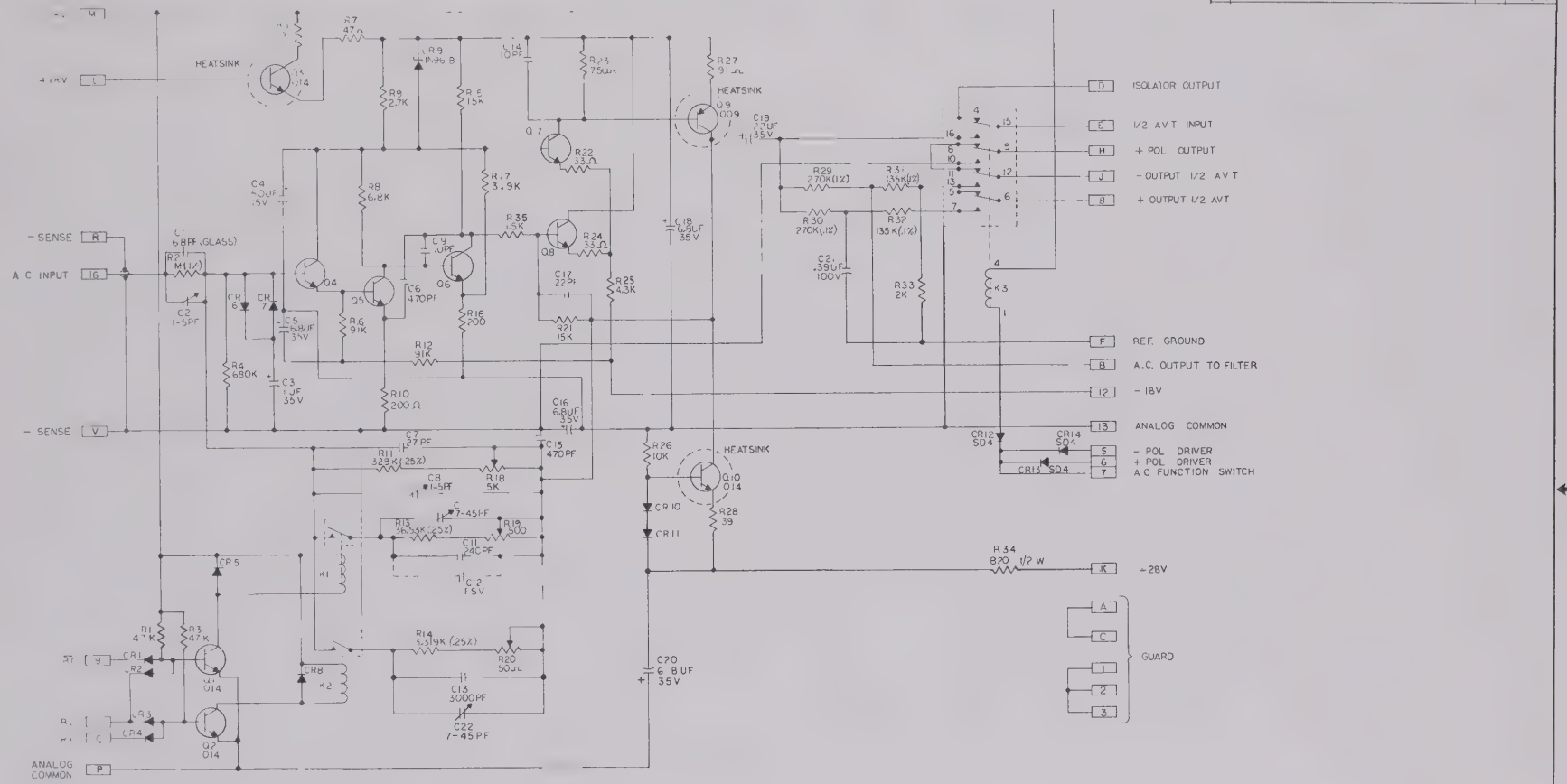
SIZE	CODE IDENT NO.	DWG NO.
D		400706 C

SCALE | WT | SHEET OF 1

2 HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO. LOCATED AS SHOWN

1 RESISTORS TO BE 1/4 W, ± 5% CARBON

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

5. Highest numbered reference designators:
   R 34 Q 10
   C 21 CR 14
4. All voltages referenced to analog common
3. All transistors 43565
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662

NOTES UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ANGLES
X ± .030 ± 0° 30'
XX ± .020
XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR		9-24-67
CHK		
APPD		11-6-67

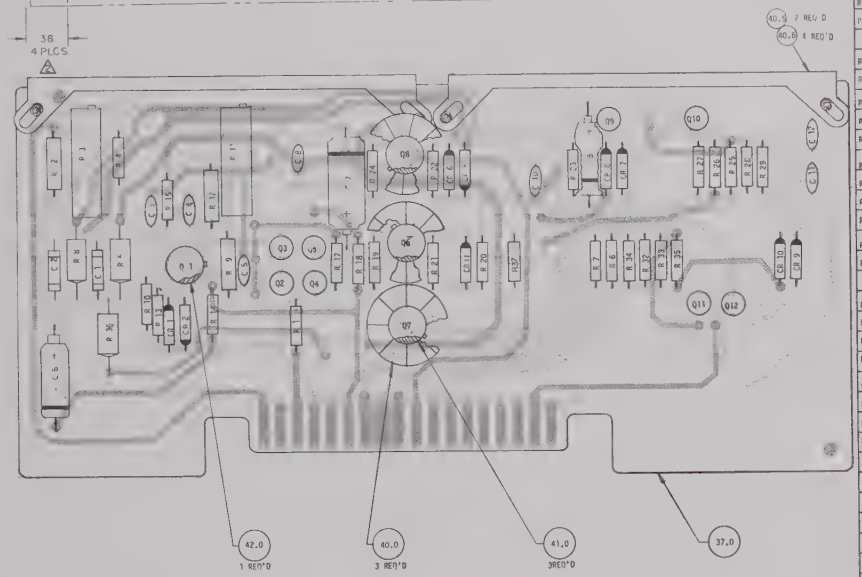
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — A.C. CONVERTER

SIZE D | CODE IDENT NO | DWG NO. 430306 B

SCALE | WT | SHEET 1 OF 1

AUTO POLARITY 400699 SERIAL NO [redacted] DANA



REF DES	B/M ITEM	DESCRIPTION
R 30	16.0	68 K
P 29	3.0	15 K
R 27	3.0	15 K
R 26	5.0	18 K
P 25	3.0	15 K
P 24	15.0	47 ohms
R 23	7.0	200 ohms
R 22	2.0	10 K
R 21	17.0	91 ohms
R 20	35.2	4.7 V
R 19	17.0	91 ohms
R 18	15.2	4.7 K
R 17	1.0	1 K
R 15	1.0	1 K
R 14	6.0	180 K
R 13	6.0	180 K
R 12	19.0	422 K (1%)
R 11	23.4	50 K (POT.)
R 10	1.0	1 K
R 9	19.0	422 K (1%)
R 8	21.0	10 K (.05%)
R 7	9.0	24 K
R 6	9.0	24 K
R 5	21.0	10 K (.05%)
R 4	14.0	39 K
R 3	23.0	5 K (POT.)
R 2	20.0	100 ohms (1%)
P 1	8.0	2 K

REF DES	B/M ITEM	DESCRIPTION
C 8	25.0	100 pf
C 7	27.7	25 MFD 50V
C 6	28.0	5 MFD 30 V
C 5	25.0	100 pf
C 4	25.0	100 pf
C 3	25.0	100 pf
C 2	29.0	24 pf
C 1	29.0	24 pf
CR 11	36.5	1/4 M24 A25
CR10	36.0	1N662
CR 7	36.0	1N662
CR 6	35.0	OHD166
CR 5	35.0	OHD166
CR 4	36.0	1N662
CR 1	36.0	1N662
R 37	12.0	390 OHMS
R 36	21.0	10 K (.05%)
R 35	10.0	30 K
R 34	4.0	16 K
P 33	10.0	30 K
R 32	4.0	16 K
R 31	16.0	68 K

REF DES	B/M ITEM	DESCRIPTION
Q 12	31.0	2N3646
Q 11	31.0	2N3646
Q 10	33.0	2N3565
Q 9	33.0	2N3565
Q 8	34.0	014
Q 7	34.0	014
Q 6	30.0	009
Q 5	31.0	2N3646
Q 4	31.0	2N3646
Q 3	33.0	2N3565
Q 2	33.0	2N3565
Q 1	32.0	016
C 12	24.0	330 pf
C 11	24.0	330 pf
C 10	25.0	100 pf
C 9	6.1	1 MFD 50 V

CROSS REFERENCE CHART	
ITEM NO	PART NO.
37.0	410166 C
40.0	600016
40.5	610236
40.6	610237
41.0	920006
42.0	920062

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL / APPLIED FINISH / HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AX S SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	1-28-65
CHK		
APPD	[illegible]	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

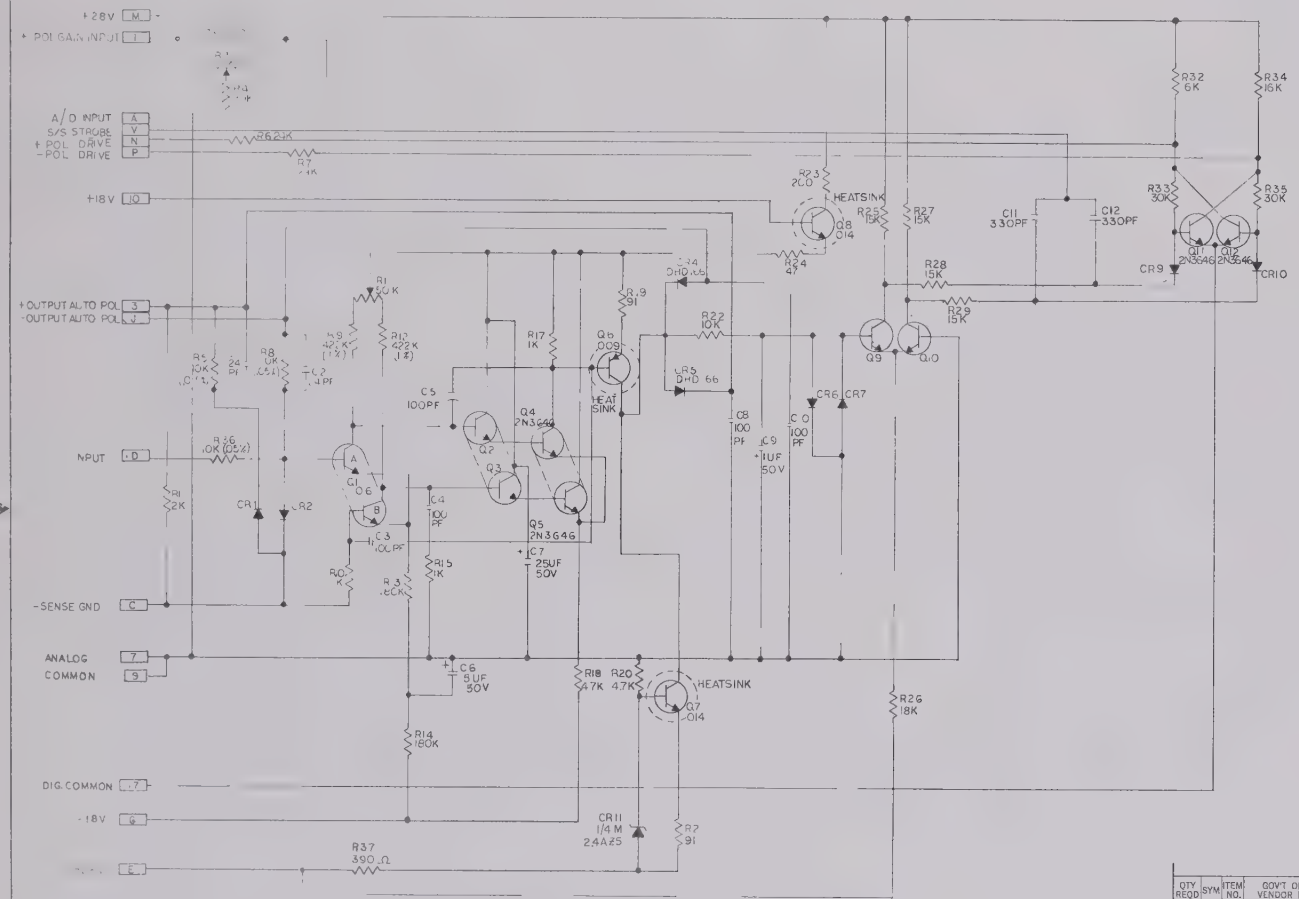
P C BOARD ASS'Y
AUTO POLARITY

SIZE D | CODE IDENT NO. | DWG NO. 400699 | E
SCALE —— | WT —— | SHEET 1 OF 1

⚠ Heat stamp .10 high black characters and .15 high logo, located as shown.

1. All resistors are 1/4W, 5% carbon.

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

5. Highest numbered reference designators
   R37 nt.
   C12 CR11
4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes IN662

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		4-23-65
CHK		30 SEPT.
APPD		1965

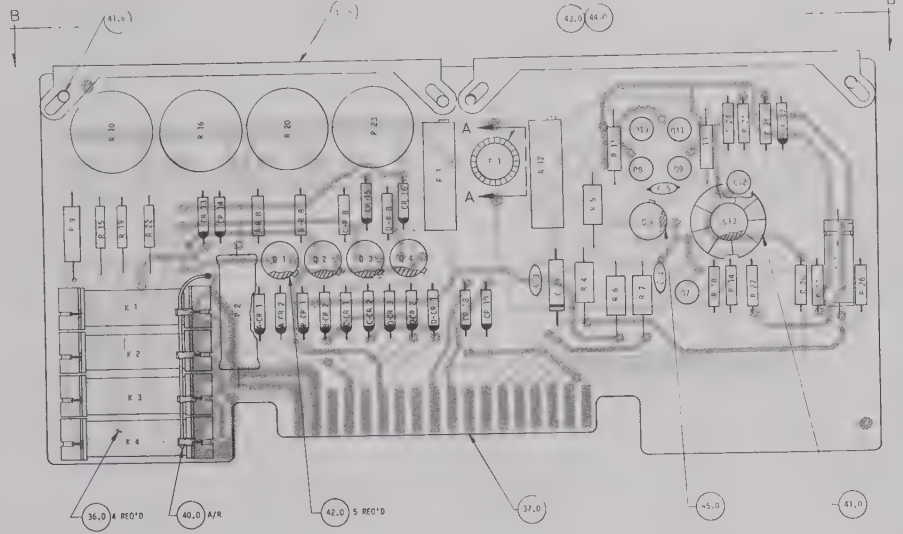
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
AUTO POLARITY

SIZE	CODE IDENT NO.	DWG NO.
D		430304

SCALE — WT — SHEET 1 OF 1

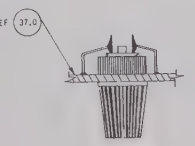
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
P	RELEASED TO PRODUCTION PILOT		
C			



REF DES	B/M ITEM	DESCRIPTION
R 4	34.0	.014
R 1	34.0	.014
CR19	33.0	39.4
CR18	33.0	39.4
CR17	35.0	2.4 V 1N4370
CR16	34.0	1N662
CR13	34.0	1N662
CR 3	34.0	1N662
CR 2	34.0	1N662
CR 1	34.0	1N662
C 5	25.0	100 pf
C 4	26.0	.001 MFD Disc
C 3	26.0	.001 MFD Disc
C 2	28.0	.0047 MFD 100 V
C 1	27.0	1 MFD 50V

REF DES	B/M ITEM	DESCRIPTION
R 19	5.0	(2
R 17	5.0	(2
R 13	13.	5% 1
R 12	30.0	1% 1/8
R 11	13.0	1% 1
R 10	23.0	5
R 9	12.	1
R 7	16.	.05
R 6		.05
R 5		5.02 K .05
R 4	18.	.05
R 3	28.0	50 K (POT)
R 2	17.	1%
Q 3	29.0	009
Q 2	32.0	2N3565
Q 1	32.0	2N3565
D 6	31.0	016

REF DES	B/M ITEM	DESCRIPTION
R 28	1.0	10 ohms
R 27	10.0	9.1 K
R 26	2.0	100 ohms
R 25	5.0	16 K
R 24	5.0	16 K
R 23	21.0	5 ohms (POT)
R 22	16.6	50C ohms 1%
R 21	6.0	2 K



SECTION A-A

OHMS CONVERTER 400705 SERIAL NO. DANA

VIEW B-B

.38
4 PLCS

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
36.0	310013
37.0	4101674
40.0	500004
41.0	600016
42.0	920006
43.0	920053
44.0	920054
45.0	920002
41.5	610236
41.6	610237

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
.X ±.030 ± 0° 30'
.XX ±.020
.XXX ±.010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR	
CHK	
APPD	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y -
OHMS CONVERTER

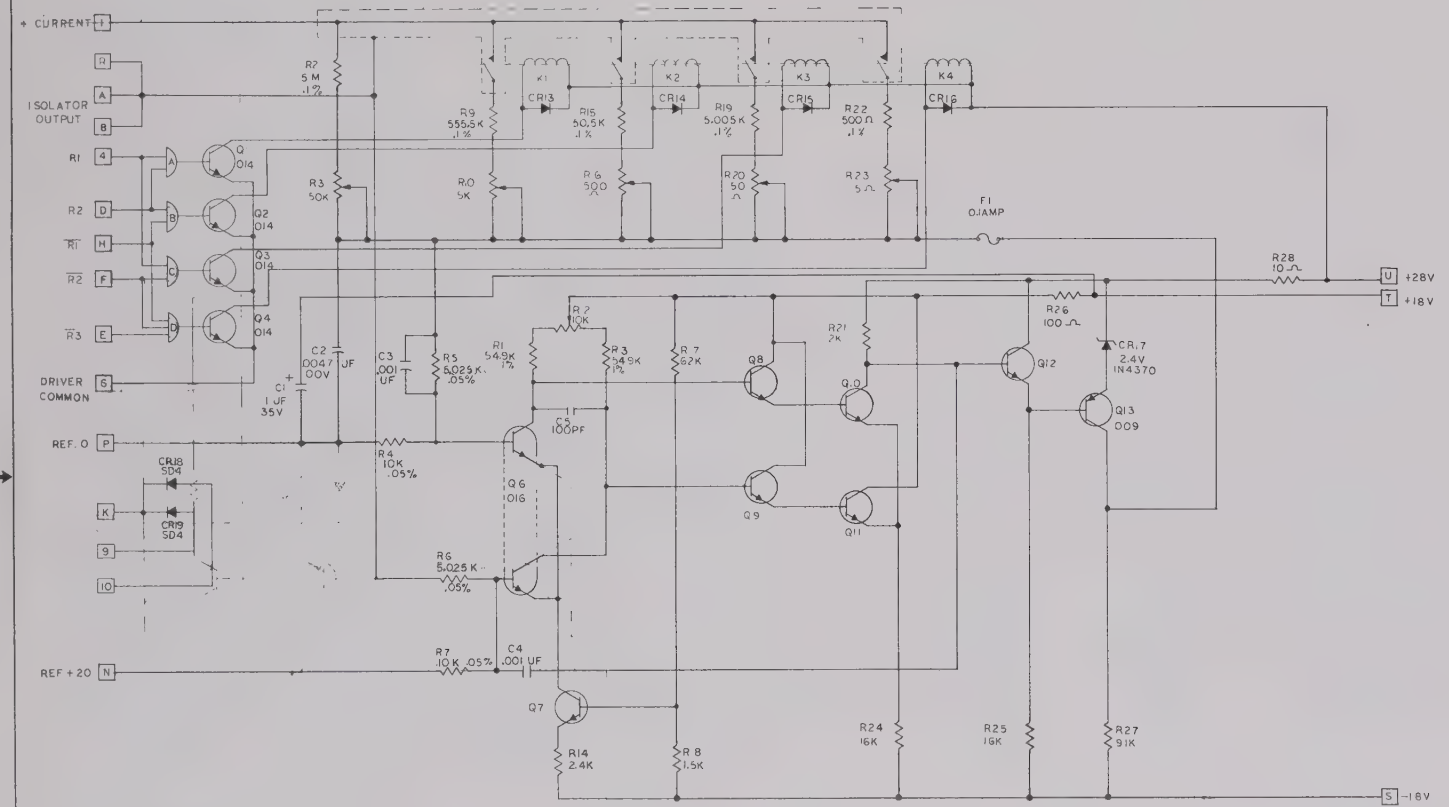
SIZE	CODE IDENT NO	DWG NO.
D		400705 C

SCALE 2 : 1 | WT | SHEET 1 OF 1

(2) Heat stamp 10 [illegible] and 15 [illegible]

1 All resistors are [illegible]

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

NOTES. UNLESS OTHERWISE SPECIFIED

1. All diodes 1N662
2. All resistors 1/4W, 5%, carbon
3. All transistors 2N3565
4. All voltages referenced to analog common
5. Highest numbered reference designators:
   R28 Ω ±
   C5 CR17
6. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

D — "AND" GATE — +28V — R8 47K — CR1 — CR2-7

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN O.A ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D 1000 AND MIL-D-70327

CONTRACT NO.

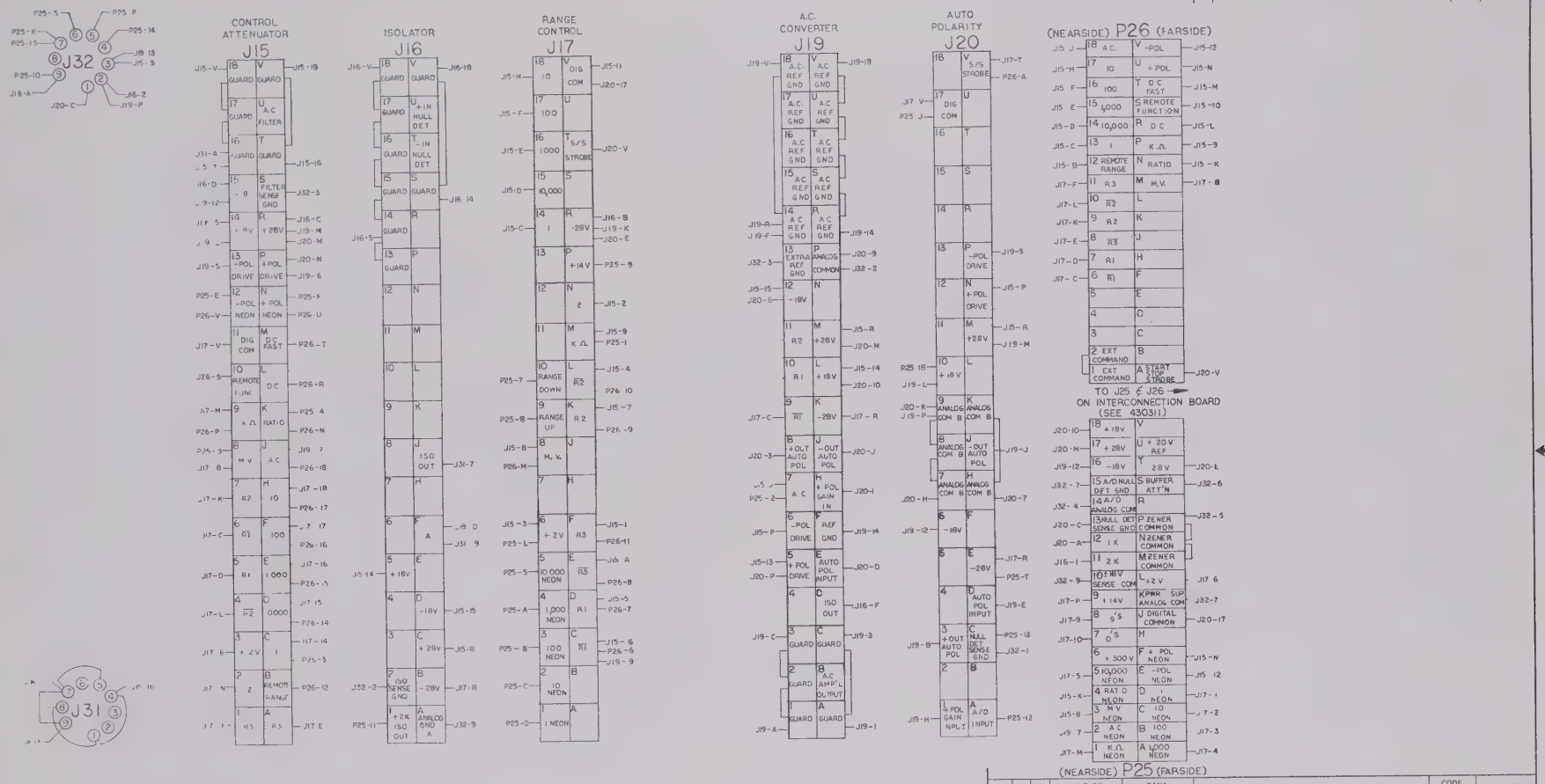
	NAME	DATE
DRA.	CHAUSSEE	9-22 65
CHK		9-28-65
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - OHMS CONVERTER

SIZE	CODE IDENT NO	DWG NO
D	—	430303

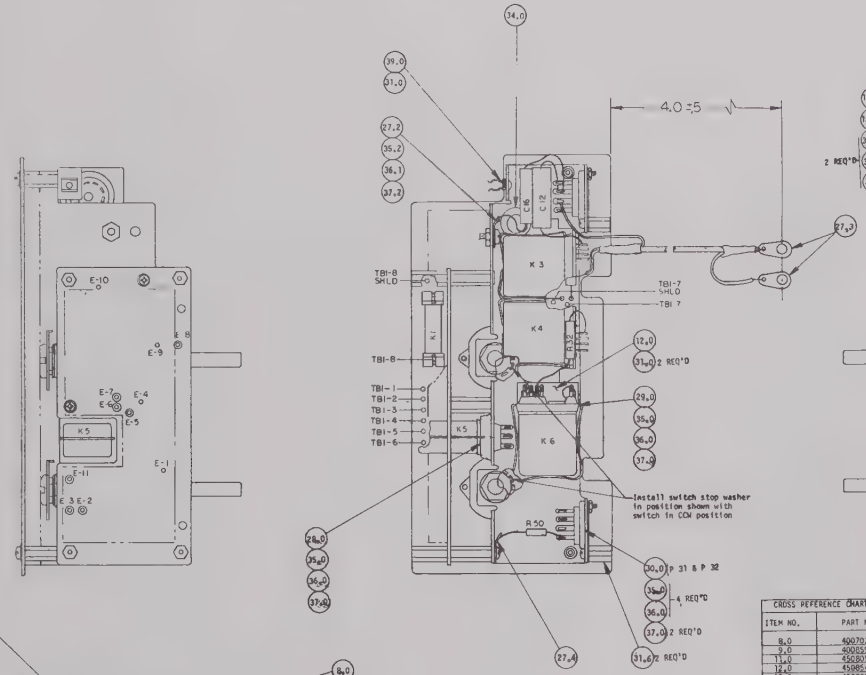
SCALE — WT — SHEET 1 OF 1

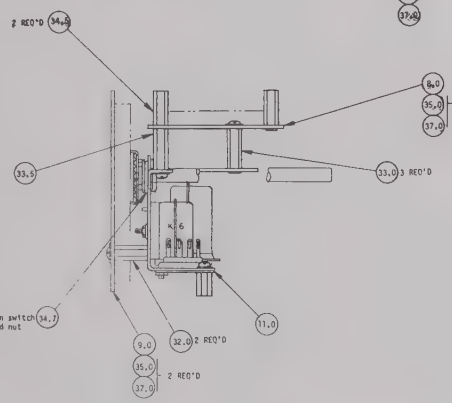

REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
J32
J31
CONTROL ATTENUATOR J15
ISOLATOR J16
RANGE CONTROL J17
A.C. CONVERTER J19
AUTO POLARITY J20
(NEARSIDE) P26 (FARSIDE)
TO J25 & J26 ON INTERCONNECTION BOARD (SEE 430311)
(NEARSIDE) P25 (FARSIDE)
QTY REQD | SYM | ITEM NO. | GOV'T OR VENDOR NO. | DANA PART NUMBER | NOMENCLATURE OR DESCRIPTION | CODE IDENT | SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .000 XX ± .020 XXX ± .010 ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED 0.10 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D-70327
CONTRACT NO.
NAME | DATE
DR | 25 FEB 1966
CHK
APPD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
WIRING DIAGRAM -- INTRACONNECTION 020
SIZE D | CODE IDENT NO | DWG NO. 430360
SCALE | WT | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

1. CONNECTOR VIEWED FROM WIRING (DIP PIN) SIDE

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED





FROM	TO	CONDUCTOR USED; COLOR	B/M ITEM NO.	WIRE LENGTH	NOTES	LINE
TBI-2	K4-4	9-2	23.0		Via Grommet (Item 34.0)	1
TBI-1	K3-1	9-1	24.0			2
TBI-4	K5-1	9-1-5	29.7			3
TBI-5	K6-	5	19.5			4
TBI-6	K6-4	9-1-6	21.0			5
TBI-7	K3-15	RG174/U	19.0			6
Shld to conn.	Shld not conn.	0	17.0 and 13.0		Tubing as Req'd	
TBI-7 Shld	K6-9	RG174/U	16.0			7
Shld to TBI-8 Shld	Shld not conn.	0	17.0 and 13.0		Via Grommet (Item 34.0) Tubing as Req'd	
E-1	K5-10	8	20.5			8
E-2	K5-5	9-1	21.9			9
E-3	K5-7	0	17.0			10
E-4	K6-13	2-1-1	19.5			11
E-5	K5-8	9-1-3	20.0			12
E-6	K4-16	2-9-6	18.0			13
E-7	K4-10	9-1-8	21.6			14
E-8	K4-11	9-1-7	21.3			15
E-9	K4-1	2-1-5	15.0			16
						17
E-11	P31-7	2-7-8	20.0			18
K3-4	K4-1	9-1	21.9			19
K3-14	K4-15	Sleeved Buss Wire	14.0 &15.0			20
K3-11	K4-9	Sleeved Buss Wire	14.0 &15.0			21
K3-8	K4-12	Sleeved Buss Wire	14.0 &15.0			22
K3-13	K5-5	RG174/U	16.0			23
Shld not conn.	Shld to conn.	0	17.0 and 13.0		Tubing as Req'd	
K3-10	P32-8	C12, .22UF/600V	3.0 &15.0		Leads Sleeved as Req'd	24
K3-15	K6-14	RG174/U	16.0			25
Shld not conn.	Shld to conn.	0	17.0 and 13.0		Tubing as Req'd	
K3-12	P31-3	RG174/U	16.0			26
Shld not conn.	Shld to P31-4	0	17.0 and 13.0		Tubing as Req'd	
K3-9	Lug (Item no. 22.3)	RG174/U	16.0			27
Shld to P32-9	Shld to Lug (Item no. 22.3)	0	17.0 and 13.0		Tubing as Req'd	
K4-1	K6-4	9-2-4	22.0			28
K4-14	K6-10	R49, 182 K C15, .0047UF/100V	2.8, 4.0 and 15.0		Resistor wired in parallel with capacitor; Leads sleeved as req'd.	29
K4-1	K6-7	R32, 887K ±1%	1.0 &15.0		Leads Sleeved as Req'd	30
K4-8	P31-9	0-9	19.5			31
K5-1	K6-6	9	25.0			32
K5-9	K6-8	RG174/U	16.0			33
Shld to P31-4	Shld not conn.	0	17.0 and 13.0		Tubing as Req'd	
K5-1	K6-4	0	17.0			34
K6-12	P31-2	RG174/U	16.0			35
Shld not conn.	Shld to P31-1	0	17.0 and 13.0		Tubing as Req'd	
K6-15	P32-5	9	25.0			36
K6-8	K6-11	Sleeved Buss Wire	14.0 &15.0			37
K6-6	K6-10	Sleeved Buss Wire	14.0 &15.0			38
P31-1	Lug (Item no. 22.4)	R50, 100K, 1/4W	.5 & 15.0		Leads Sleeved as Req'd	39
P32-3	Lug (Item no. 22.2	C16, .1 UF/100V	2.8 &15.0		Leads Sleeved as Req'd	40

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
8.0	4007030
9.0	400059
11.0	4508056
12.0	4508548
12.5	452090
12.6	452001
21.0	600022
28.0	600221
29.0	600222
31.0	610019
31.2	610101
31.4	610111
31.6	610118
32.0	610140
33.0	610155
33.5	610162
34.0	610172
34.5	610240
35.0	615042
35.6	615057
36.0	617016
36.1	617017
37.0	617077
39.0	920113

R 50	±.5	100 K 1/4W
R 47	2.0	182 K 1/4W
R 32	4.0	887 K 1 %
K 6	7.5	4PDT 310030
K 5	7.4	DPDT 310028
K 4	7.5	4PDT 310030
K 3	7.5	4PDT 310030
C 16	2.8	.1 MFD 100V
C 15	4.0	.0047 MFD 100V
C 12	3.0	.22 MFD 600V
REF DES	B/M ITEM	DESCRIPTION

RELAY TERMINAL LAYOUTS

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NOTES UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS | ANGLES
.X ± .030 | ± 0 30'
.XX ± .020
.XXX ± .010
FORMED ANGLES ± 1 0°
ECCENTRICITY BETWEEN DIA ON THE SAME AX S SHALL NOT EXCEED .010 TIR.
NTERPRET DRAWING N ACCORDANCE WITH STANDARDS M L D 1000 AND MIL D 70327

CONTRACT NO.

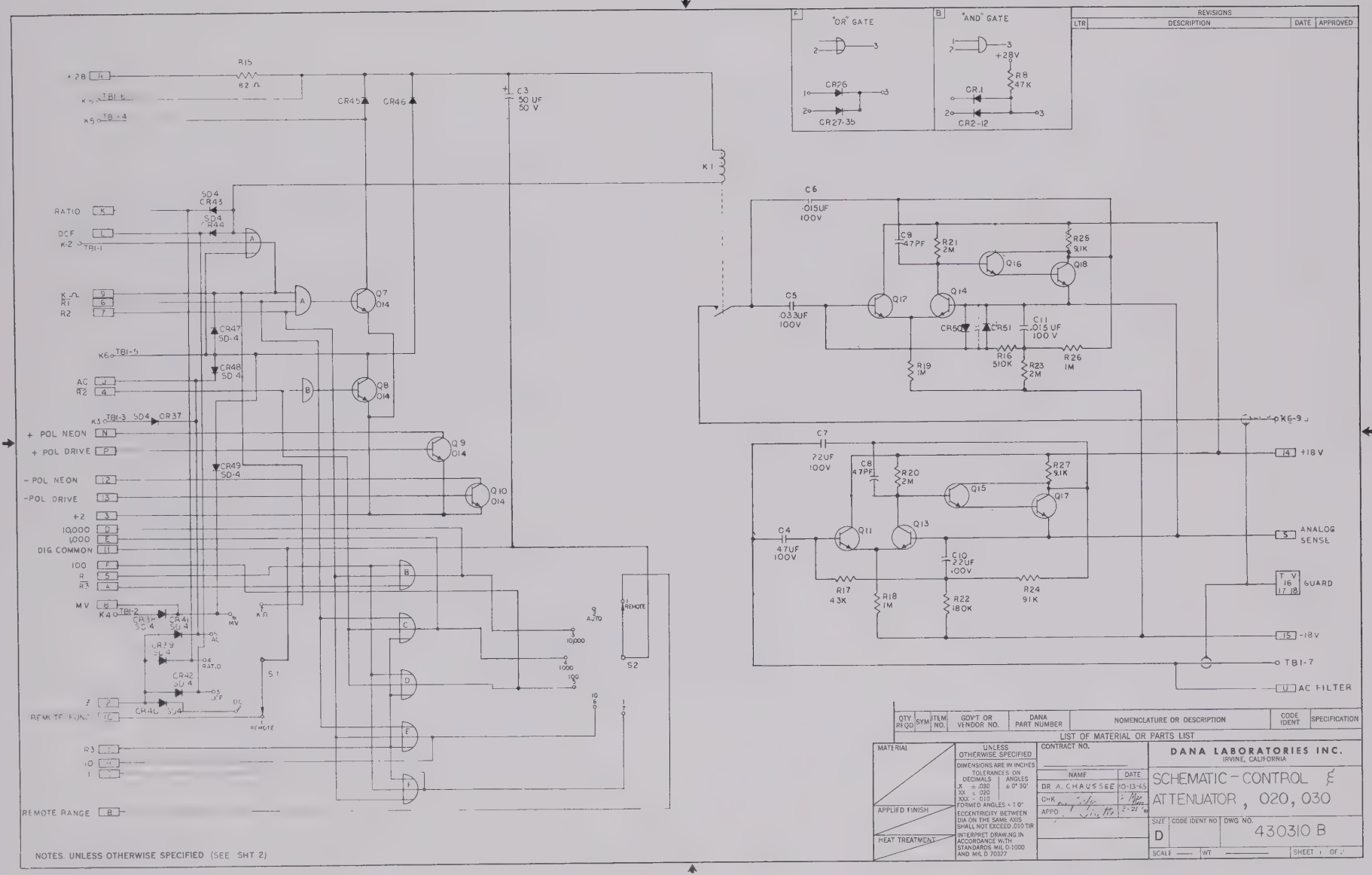
	NAME	DATE
DR		11 MAR 1 141
CHK		2 APR 141
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ATTENUATOR & CONTROL ASSY - 020

SIZE	CODE IDENT NO.	DWG NO.
D		400858

SCALE 1/1 | WT | SHEET 1 OF 1



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY PER UNIT	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010 | ANGLES ± 0° 30'

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	A. CHAUSSEE	10-13-65
CHK		
APPD		2-21-66

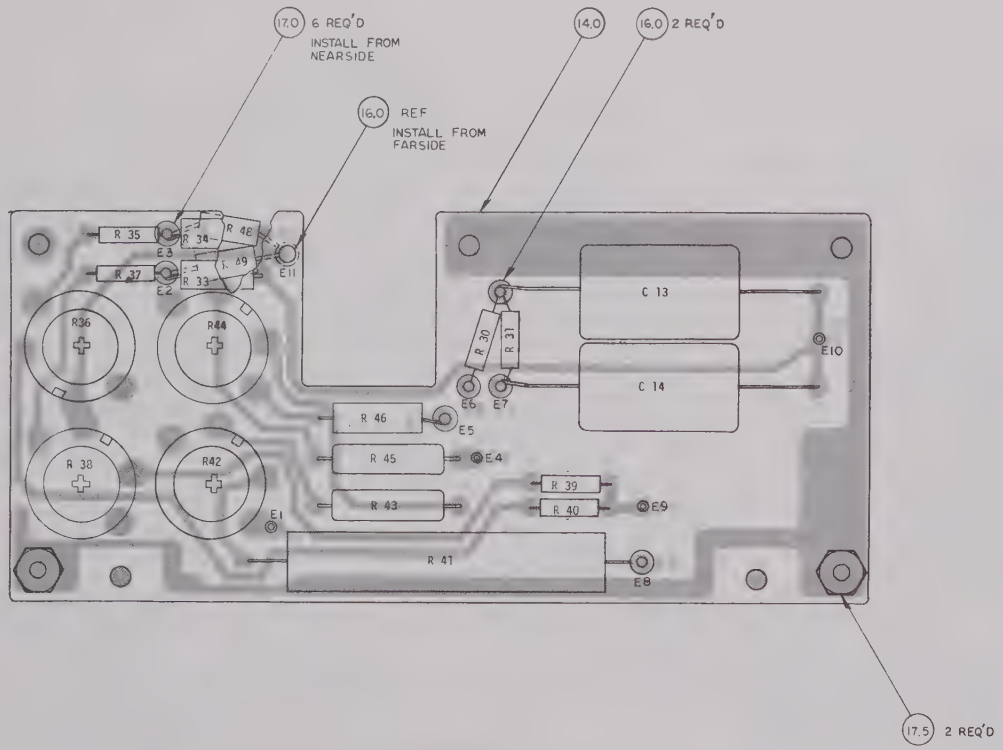
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - CONTROL & ATTENUATOR, 020, 030

SIZE D | CODE IDENT NO | DWG NO. 430310 B

SCALE — | WT — | SHEET 1 OF 2

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 49	8.0	10 K .05%
R 48	8.0	10 K .05%
R 46	5.0	806 K 1% (RN65)
R 45	6.0	99.75 K 1/4W (SET)
R 44	12.3	500 ohms (POT)
R 43	6.0	897.2 K, 1/4W (SET)
R 42	12.0	5 K (POT)
R 41	6.0	8.997 Meg (SET)
R 40	2.0	150 K
R 39	1.0	15 K
R 38	12.0	5 K (POT)
R 37	3.	820 K
R 36	12.0	5 K (POT)
R 35	4.0	82 K
R 34	10.0	100.83 ohms, .05%WW
R 33	10.4	1.1111 K, .05% WW
R 31	4.5	4.99 K RN60D
R 30	4.5	4.99 K RN60D
C 14	13.0	4.7 MFD 60V
C 13	13.0	4.7 MFD 60V

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
14.0	410171
16.0	600030
17.0	600243
17.5	610140

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
LIST OF MATERIALS OR PARTS LIST						

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA..... SUB—ASSY MRA.... MAJOR REPL ASSY
MA..... MODULE ASSY CA..... COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .X ± .030 .XX ± .020 .XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN	W. Edie	18 Nov. 1965
CHECK	WMS Curdy	19 NOV 65
ENGR		
APPR		12/13/65

APPROVED

APPROVED

Rel 12-13-65
DRN # 217

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y- ATTENUATOR

CODE IDENT NO.	SIZE		
—	C	400703	B
SCALE 2/1	WEIGHT —	SHEET 1 OF 1	

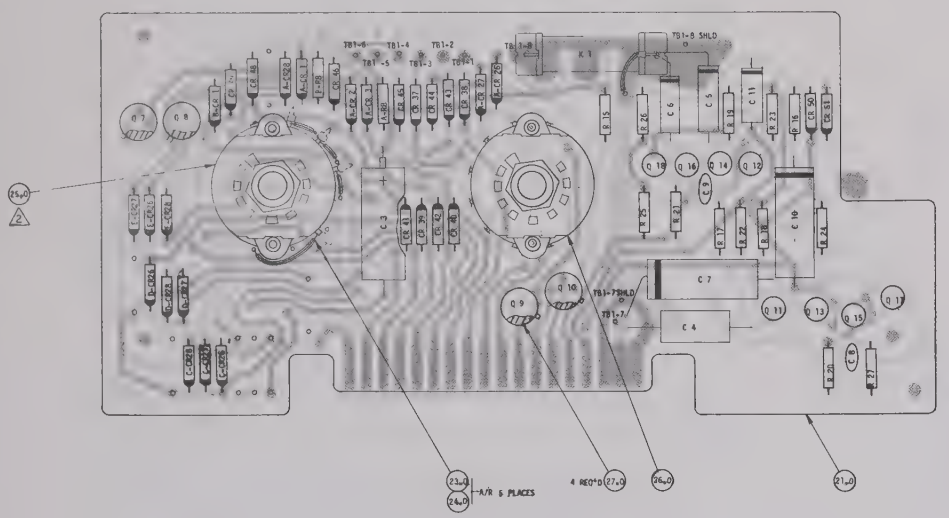
1. . Resistors to be 1/4W ± 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED

586-00 LIETZ 1030 TOPS-LIGHT 4-64

B| 400703 |

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
CR 46	19.0	1N662
CR 45	19.0	1N662
CR 44	18.0	SD4
thru		
CR 37	18.0	SD4
CR 28	19.0	1N662
A-CR28	18.0	SD4
CR 27	19.0	1N662
A-CR27	18.0	SD4
CR 26	19.0	1N662
A-CR26	18.0	SD4
CR 4	19.0	1N662
CR 3	19.0	1N662
B-CR1	19.0	1N662
A-CR2	19.0	1N662
A-CR1	18.0	SD4
C 11	13.5	.015 MFD 100 V
C 10	14.0	.22 MFD 100 V
C 9	10.0	47 PF DISC
C 8	10.0	47 PF DISC
C 7	14.0	.22 MFD 100 V
C 6	13.5	.015 MFD 100 V
C 5	15.0	.033 MFD 100 V
C 4	12.3	.47 MFD 100 V
C 3	11.0	50 MFD 50 V

REF DES	B/M ITEM	DESCRIPTION
Q 18	17.0	2N3565
thru		
Q 11	17.0	2N3565
Q 10	16.0	014
thru		
Q 7	16.0	014
R 27	8.0	9.1 K
R 26	1.0	1 MEG
R 25	8.0	9.1 K
R 24	9.0	91 K
R 23	3.0	2 MEG
R 22	2.0	180 K
R 21	3.0	2 MEG
R 20	3.0	2 MEG
R 19	1.0	1 MEG
R 18	1.0	1 MEG
R 17	4.0	43 K
R 16	6.0	510 K
R 15	7.0	82 OHMS
R 8	5.0	47 K
K 1	20.0	RELAY 310013
CR 51	19.0	1N662
CR 50	19.0	1N662
CR 49	18.0	SD4
CR 48	18.0	SD4

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
21.0	410163 E
23.0	500004
24.0	501176
25.0	600218A
26.0	600236A
27.0	920006

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS M.I.L. D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	2-21-66
CHK	[illegible]	21 MARCH 1966
APPD	[illegible]	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — SWITCH PANEL , 020

SIZE	CODE IDENT NO.	DWG NO
D		400859

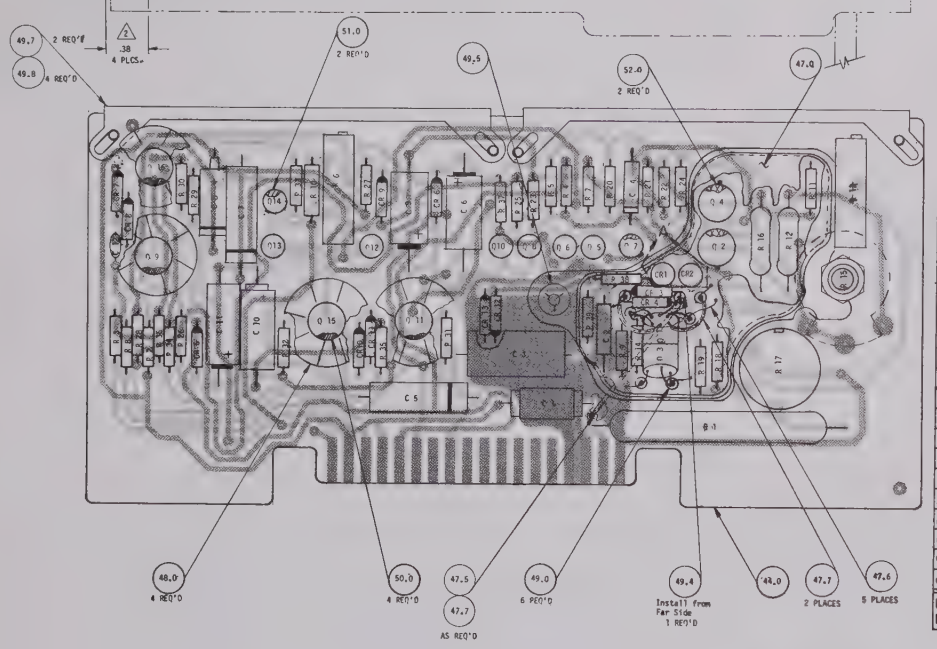
SCALE 2/1 | WT — | SHEET 1 OF 1

2. Straighten switch contacts (except wiper) clip off 3 and wire remaining 4 as shown.

1. All resistors 1/4W, 5%, Carbon.

NOTES UNLESS OTHERWISE SPECIFIED

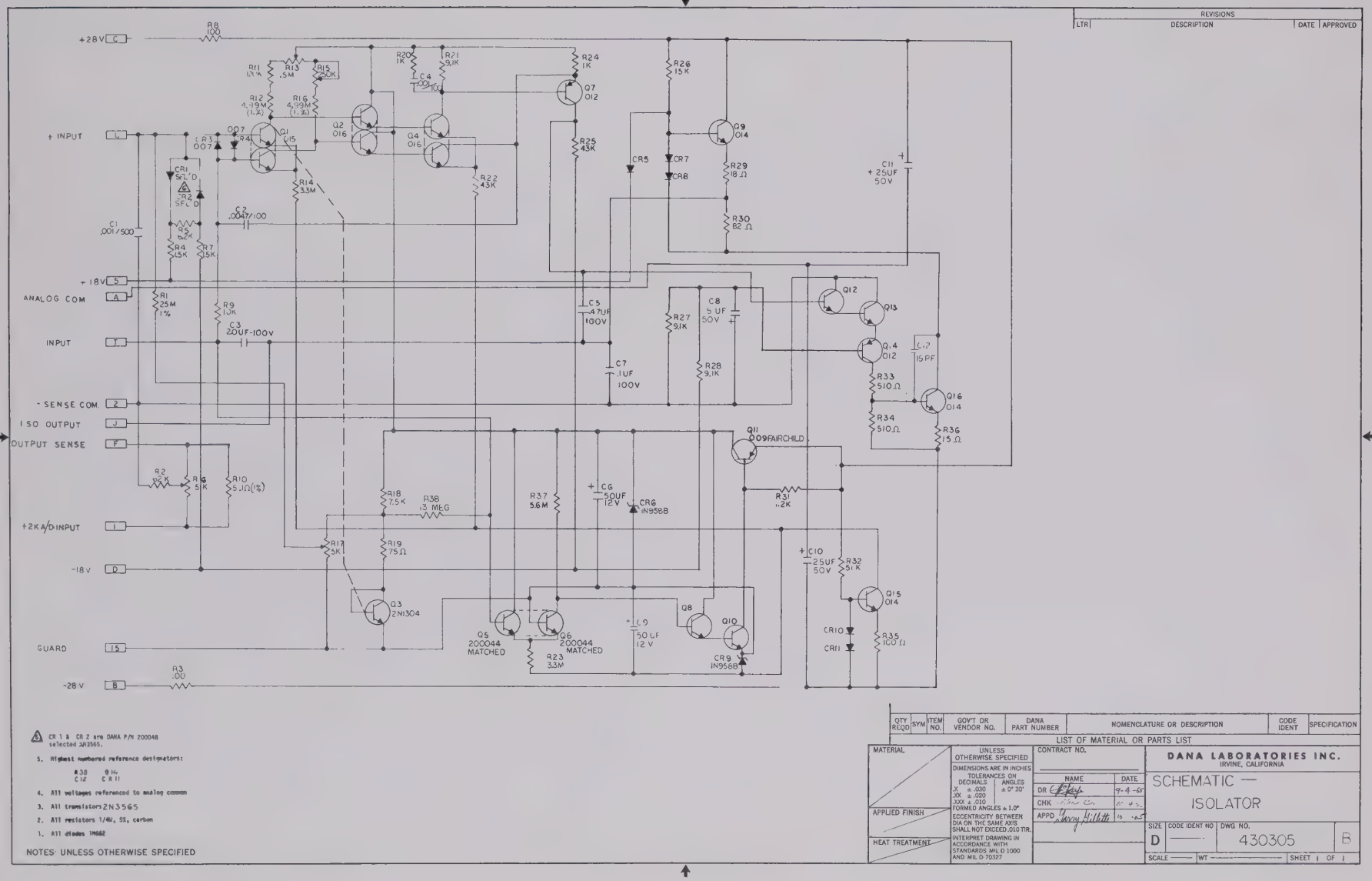
ISOLATOR 400700 SERIAL NO DANA



REF DES	B/M ITEM	DESCRIPTION
R 1	22.0	25 Meg 1 T
CR13	42.0	1N662
CR12	42.0	1N662
CR11	42.0	1N662
CR10	42.0	1N662
CR 9	43.0	1N958B
CR 8	42.0	1N662
CR 7	42.0	1N662
CR 6	43.0	1N958B
CR 5	42.0	1N662
CR 4	42.5	007
CR 3	42.5	007
CR 2	39.5	200048
CR 1	39.5	200048
C 12	25.5	15 pf DISC
C 11	26.0	25 MFD 50 V
C 10	26.0	25 MFD 50 V
C 9	27.0	50 MFD 12/15 V
C 8	28.0	5 MFD 50 V
C 7	29.0	.1 MFD 100 V
C 6	27.0	50 MFD 12/15 V
C 5	29.0	.1 MFD 100 V
C 4	31.0	.001 MFD 100 V
C 3	30.0	2.0 MFD 100 V
C 2	32.0	.0047 MFD 100 V
C 1	29.1	.001 MFD 500 V

REF DES	B/M ITEM	DESCRIPTION
R 31	4.0	1.2 K
P 30	19.0	82 ohms
R 29	9.0	18 ohms
R 28	20.0	9.1 K
R 27	20.0	9.1 K
R 26	8.0	15 K
R 25	11.0	43 K
R 24	2.0	1 K
R 23	10.0	3.3 Meg
R 22	10.5	39 K
R 21	20.0	9.1 K
R 20	2.0	1 K
R 19	17.0	75 ohms
R 18	18.0	7.5 K
R 17	23.0	5 K POT
R 16	21.0	4.99 Meg 1%
P 15	24.0	250 K POT
R 14	10.0	3.3 Meg
R 13	25.0	500 K POT
R 12	21.0	4.99 Meg 1%
R 11	5.0	120 K
R 10	22.2	51.1 ohms 1%
R 9	9.5	2.4K
R 8	1.0	100 ohms
R 7	7.0	1.5 K
R 6	22.8	5 K POT
R 5	16.0	6.2 K
R 4	7.0	1.5 K
R 3	1.0	100 ohms
R 2	16.1	62 K

REF DES	B/M ITEM	DESCRIPTION



REVISIONS

LTR	DESCRIPTION	DATE	APPROVED

3. CR 1 & CR 2 are DANA P/N 200048 selected JAN3565.

5. Highest numbered reference designators:
   R38 Q14
   C12 CR11

4. All voltages referenced to analog common

3. All transistors 2N3565

2. All resistors 1/4W, 5%, carbon

1. All diodes IN662

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	9-4-65
CHK	[illegible]	[illegible]
APPD	Harry Gillette	10-[illegible]

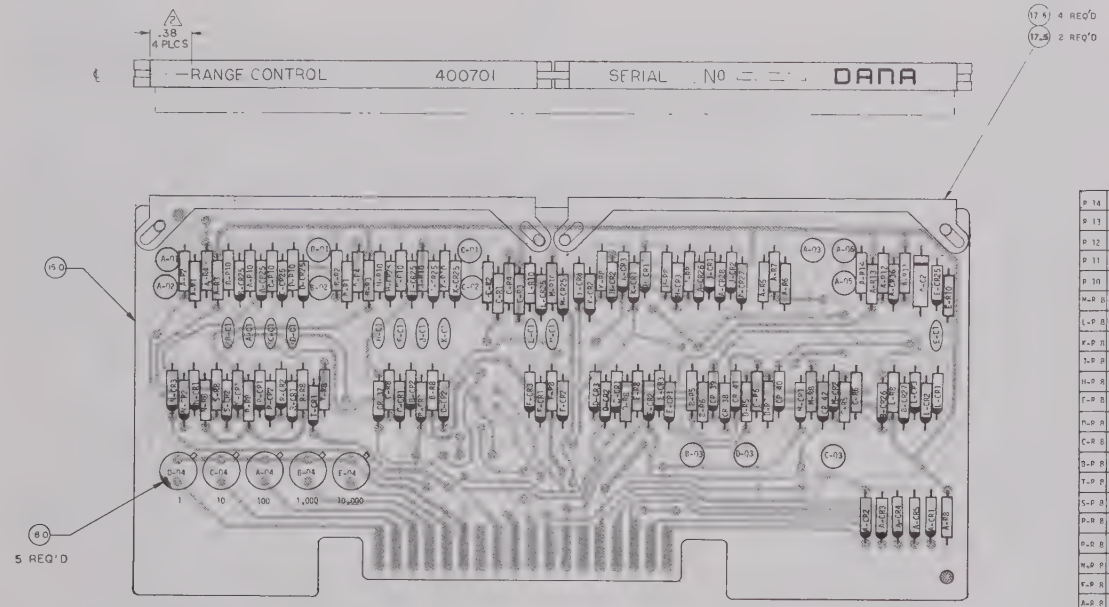
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
ISOLATOR

SIZE	CODE IDENT NO	DWG NO.	
D	——	430305	B

SCALE —— WT —— SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 14	2.0	15 K
R 13	8.0	8.2 K
R 12	8.0	8.2 K
R 11	4.0	24 K
R 10	5.0	27 K
M-R 9	8.0	8.2 K
L-R 8	8.0	8.2 K
K-R 8	8.0	8.2 K
J-R 8	8.0	8.2 K
H-R 8	8.0	8.2 K
F-R 8	7.0	5.1 K
D-R 8	7.0	5.1 K
C-R 8	1.0	12 K
B-R 8	1.0	12 K
T-R 8	4.0	24 K
S-R 8	4.0	24 K
P-R 8	4.0	24 K
N-R 8	4.0	24 K
M-R 8	4.0	24 K
K-R 8	4.0	24 K
A-R 8	4.0	24 K
R 7	3.0	200 K
R 6	2.0	15 K
R 5	8.0	8.2 K
R 4	2.0	15 K
R 3	3.5	2.2 K
R 2	2.0	15 K
R 1	3.5	2.2 K

REF DES	B/M ITEM	DESCRIPTION
CR42	14.0	1N662
CR41	14.0	1N662
CR40	14.0	1N662
CR39	14.0	1N662
CR38	13.0	SD 4
CR37	13.0	SD 4
CR36	14.0	1N662
CR25	14.0	1N662
M-CR4	13.0	SD 4
L-CR4	13.0	SD 4
K-CR3	13.0	SD 4
J-CR3	13.0	SD 4
CR 3	14.0	1N662
H-CR2	13.0	SD 4
F-CR2	13.0	SD 4
E-CR2	13.0	SD 4
A-CR2	13.0	SD 4
CR 2	14.0	1N662
A-CR1	13.0	SD 4
CR 1	14.0	1N662
C 2	10.0	.0022 MFD, 100 V
C 1	9.0	330 pf
C 1	9.5	150 pf

REF DES	B/M ITEM	DESCRIPTION
Q 6	11.0	2N3646
Q 5	11.0	2N3646
Q 4	10.8	2N
Q 3	11.0	2N3646
Q 2	11.0	2N3646
Q 1	11.0	2N3646

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
15.0	410160A
17.5	610236
17.6	610237
18.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ±.030, XX ±.020, XXX ±.010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	24 SEP 65
CHK	[illegible]	[illegible]
APPD	[illegible]	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSEMBLY-
RANGE CONTROL

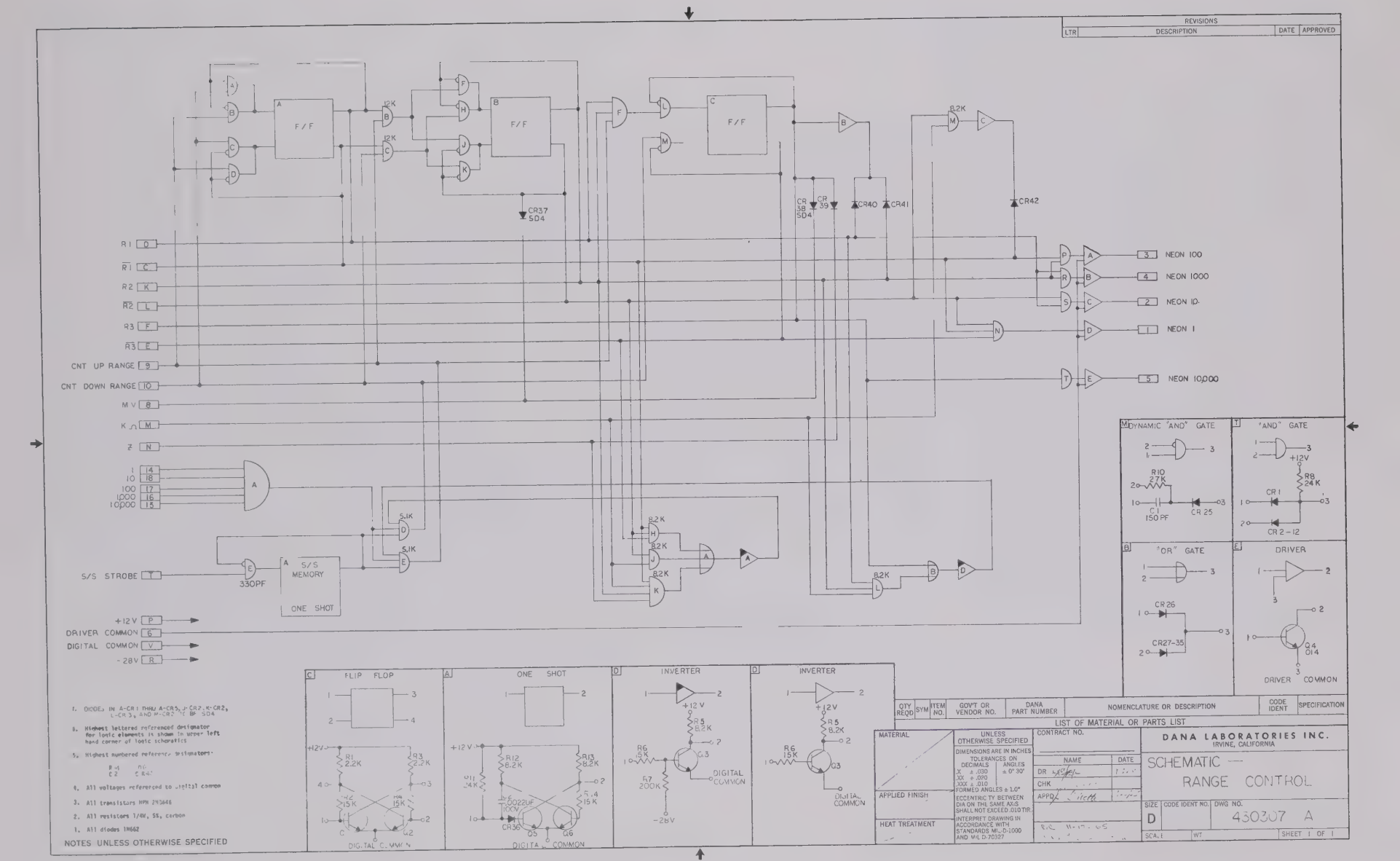
SIZE	CODE IDENT NO.	DWG NO.
D	—	400701

SCALE 2/1 | WT | SHEET OF 1

2 HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.

1 ALL RESISTORS 1/4 W, 5%, CARBON

NOTES: UNLESS OTHERWISE SPECIFIED



1. DIODES IN A-CR1 THRU A-CR5, J-CR2, K-CR2, L-CR3, AND M-CR2 ARE SD4
2. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics
3. Highest numbered reference designators:
   R-4 C-2
   C-2 CR-42
4. All voltages referenced to digital common
3. All transistors MPR 2N3646
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662

NOTES UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, .XX ± .020, .XXX ± .010 | ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D-70327

CONTRACT NO.

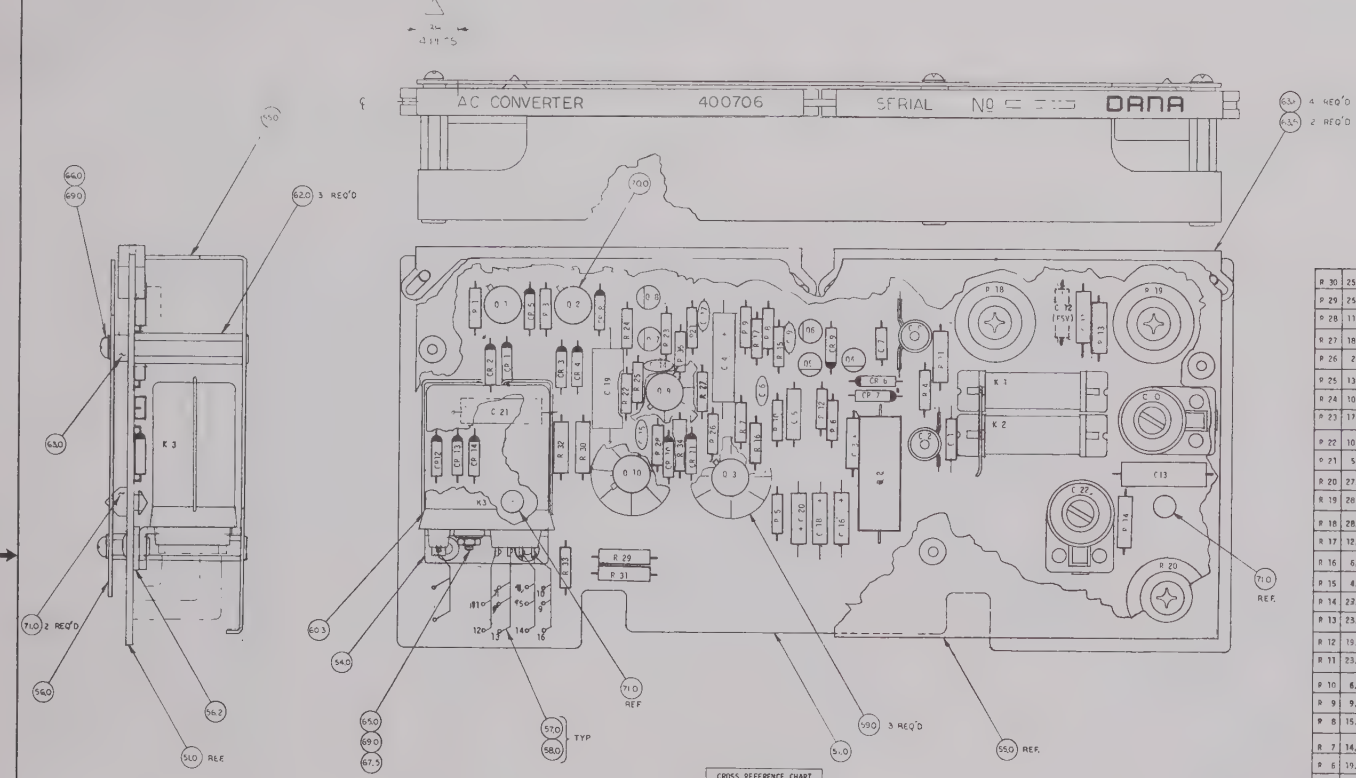
	NAME	DATE
DR		
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
RANGE CONTROL

SIZE D | CODE IDENT NO. | DWG NO. 430307 A
SCALE | WT | SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 30	25.0	270 K .1%
R 29	25.0	270 K .1%
R 28	11.0	39 ohm
R 27	18.0	91 ohm
R 26	2.0	10 K
R 25	13.0	4.3 K
R 24	10.0	33 ohm
R 23	17.0	250 ohm
R 22	10.0	33 ohm
R 21	5.0	15 K
R 20	27.0	50 ohm, CTS
R 19	28.5	500 ohm, CTS 10 %
R 18	28.0	5 K, CTS
R 17	12.0	3.9 K
R 16	6.0	200 ohm
R 15	4.0	1.5 K
R 14	22.5	3,319 K, .25% MATCH SET
R 13	23.5	36.53 K, .25% MATCH SET
R 12	19.0	91 K
R 11	23.5	329 K, .25% MATCH SET
R 10	8.0	200 ohm
R 9	9.0	2.7 K
R 8	15.0	6.8 K
R 7	14.0	47 ohm
R 6	19.0	91 K
R 5	1.0	100 ohm
R 4	16.0	680 K
R 3	14.3	47 K
R 2	23.5	1 M, .1% MATCH SET
R 1	14.3	47 K

REF DES	B/M ITEM	DESCRIPTION
C 22	42.0	7-45 pf
C 21	37.0	.39 MFD 100V
C 20	32.0	6.8 MFD 35V
C 19	33.0	22 MFD 35 V
C 18	32.0	6.8 MFD 35V
C 17	29.0	22 pf
C 16	32.0	6.8 MFD 35V
C 15	31.0	470 pf
C 14	30.0	10 pf
C 13	42.6	3000 pf
C 12		F5V (Normally not Used)
C 11	42.5	240 pf
C 10	42.0	7-45 pf
C 9	30.0	10 pf
C 8	40.0	1-5 pf
C 7	42.4	27 pf 5%
C 6	31.0	470 pf
C 5	32.0	6.8 MFD 35V
C 4	35.0	50 MFD 15V
C 3	34.0	1 MFD 35V
C 2	40.0	1-5 pf
C 1	41.0	6.8 pf, Glass
R 35	4.0	1.5 K
R 34	19.5	820 ohm 1/2 W
R 33	7.0	2 K
R 32	24.0	135 K, .1%
R 31	24.0	135 K, .1%

REF DES	B/M ITEM	DESCRIPTION
K 3	50.0	4 PDT
K 2	49.0	SPST
K 1	49.0	SPST
Q 10	44.0	014
Q 9	43.0	009
Q 8	45.0	2N3565
Q 7	45.0	2N3565
Q 6	45.0	2N3565
Q 5	45.0	2N3565
Q 4	45.0	2N3565
Q 3	44.0	014
Q 2	44.0	014
Q 1	44.0	014
CR14	46.0	CR 4
CR13	46.0	CR 4
CR12	46.0	CR 4
CR11	47.0	1N662
CR10	47.0	1N662
CR 9	47.0	1N961R
CR 8	47.0	1N662
CR 7	47.0	1N662

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
51.0	410159C
54.0	450854
55.0	450960
56.0	450961
56.2	450963
57.0	500004
58.0	501376
59.0	600016
60.3	600222
62.0	610220
63.0	610221
63.5	610236
63.6	610237
65.0	615242
66.0	615244
67.5	617016
69.0	617077
70.0	920006
71.0	920033

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR		
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASSY-
AC CONVERTER

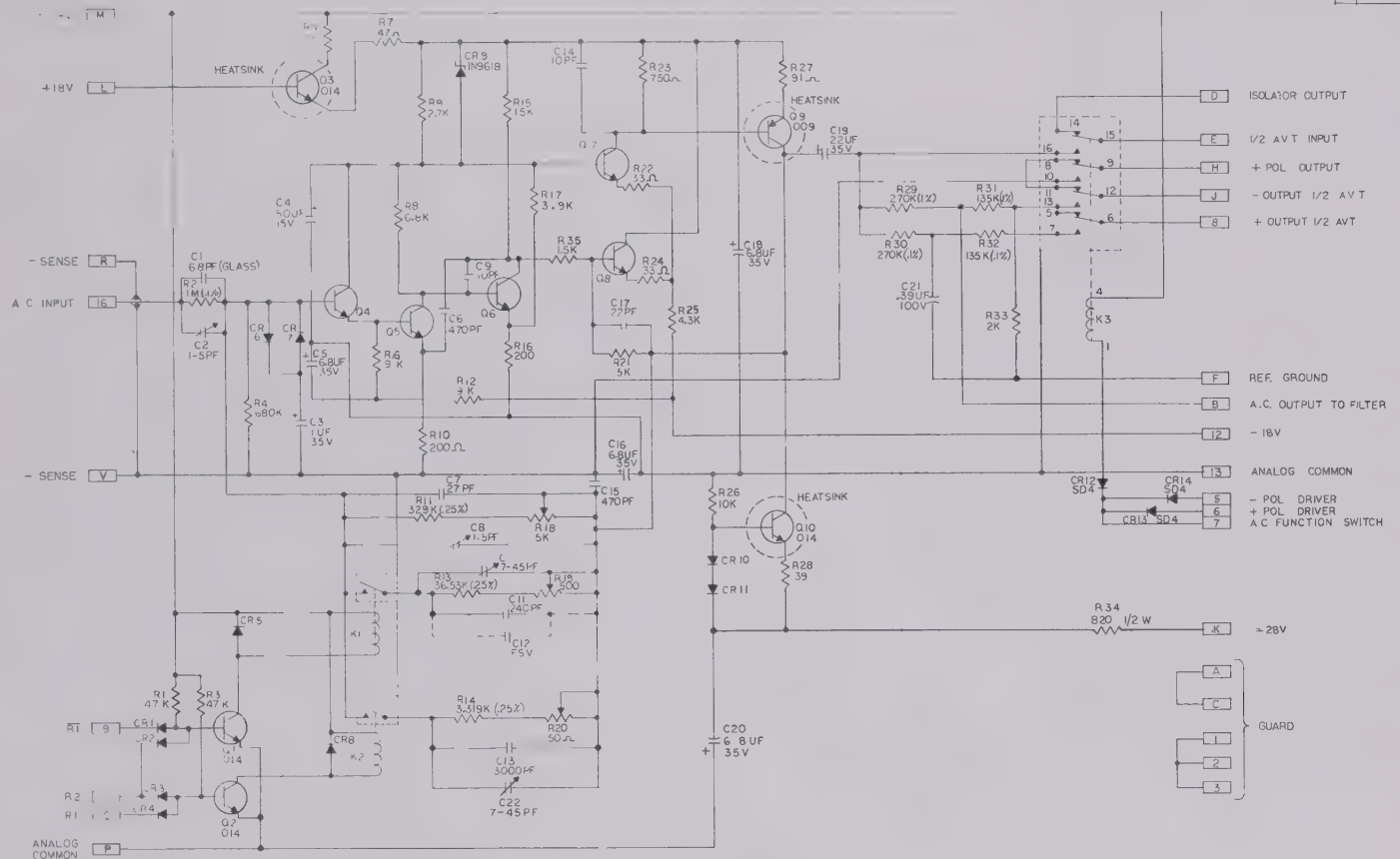
SIZE	CODE IDENT NO.	DWG NO.
D	—	400706 C

SCALE | WT — | SHEET OF 1

⚠ HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN

1. RESISTORS TO BE 1/4 W, ± 5% CARBON

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN O.A. ON THE SAME AXIS SHALL NOT EXCEED 010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO

	NAME	DATE
DR		
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
A.C. CONVERTER

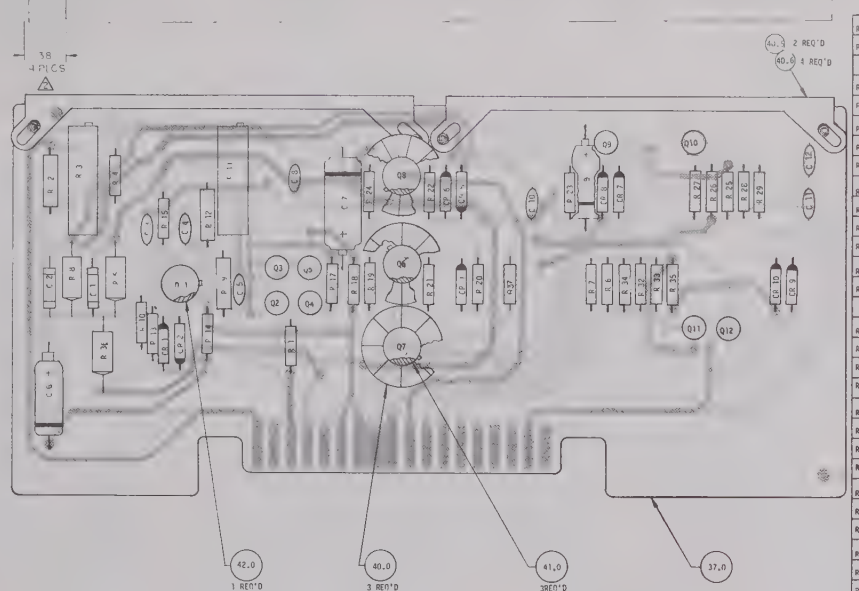
SIZE	CODE IDENT NO	DWG NO.
D		430306 B

SCALE | WT | SHEET 1 OF 1

5. Highest numbered reference designators:
   R34 Q10
   C21 CR14
4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662

NOTES UNLESS OTHERWISE SPECIFIED

AUTO POLARITY 400699 SER A. NO. DANA



REF DES	B/M ITEM	DESCRIPTION
R 30	16.0	68 K
R 29	3.0	15 K
R 27	3.0	15 K
R 26	5.0	18 K
R 25	3.0	15 K
R 24	15.0	47 ohms
R 23	7.0	200 ohms
R 22	2.0	10 K
R 21	17.0	91 ohms
R 20	15.2	4.7 K
R 19	17.0	91 ohms
R 18	15.2	4.7 K
R 17	1.0	1 K
R 15	1.0	1 K
R 14	6.0	180 K
R 13	6.0	180 K
R 12	19.0	422 K (1%)
R 11	23.0	50 K (POT.)
R 10	1.0	1 K
R 9	19.0	422 K (1%)
R 8	21.0	10 K (.05%)
R 7	9.0	24 K
R 6	9.0	24 K
R 5	21.0	10 K (.05%)
R 4	14.0	39 K
R 3	23.0	5 K (POT.)
R 2	20.0	100 ohms (1%)
R 1	8.0	2 K

REF DES	B/M ITEM	DESCRIPTION
C 8	25.0	100 pf
C 7	27.7	25 MFD 50V
C 6	28.0	5 MFD 30 V
C 5	25.0	100 pf
C 4	25.0	100 pf
C 3	25.0	100 pf
C 2	29.0	24 pf
C 1	29.0	24 pf
CR 1	36.5	1/4 M24 AZ5
CR10	36.0	1N662
CR 7	36.0	1N662
CR 6	35.0	DHD166
CR 5	35.0	DHD166
CR 4	36.0	1N662
CR 1	36.0	1N662
R 37	12.0	390 OHMS
R 36	21.0	10 K (.05%)
R 35	10.0	30 K
R 34	4.0	16 K
R 33	10.0	30 K
R 32	4.0	16 K
R 31	16.0	68 K

REF DES	B/M ITEM	DESCRIPTION
Q 12	31.0	2N3646
Q 11	31.0	2N3646
Q 10	33.0	2N3565
Q 9	33.0	2N3565
Q 8	34.0	014
Q 7	34.0	014
Q 6	30.0	009
Q 5	31.0	2N3646
Q 4	31.0	2N3646
Q 3	33.0	2N3565
Q 2	33.0	2N3565
Q 1	32.0	016
C 12	24.0	330 pf
C 11	24.0	330 pf
C 10	25.0	100 pf
C 9	8.1	1 MFD 50 V

CROSS REFERENCE CHART	
ITEM NO	PART NO.
37.0	410166 C
40.0	600016
40.3	610236
40.6	610237
41.0	920006
42.0	920062

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND M L D 70327

CONTRACT NO.

	NAME	DATE
DR		11-28-67
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y
AUTO POLARITY

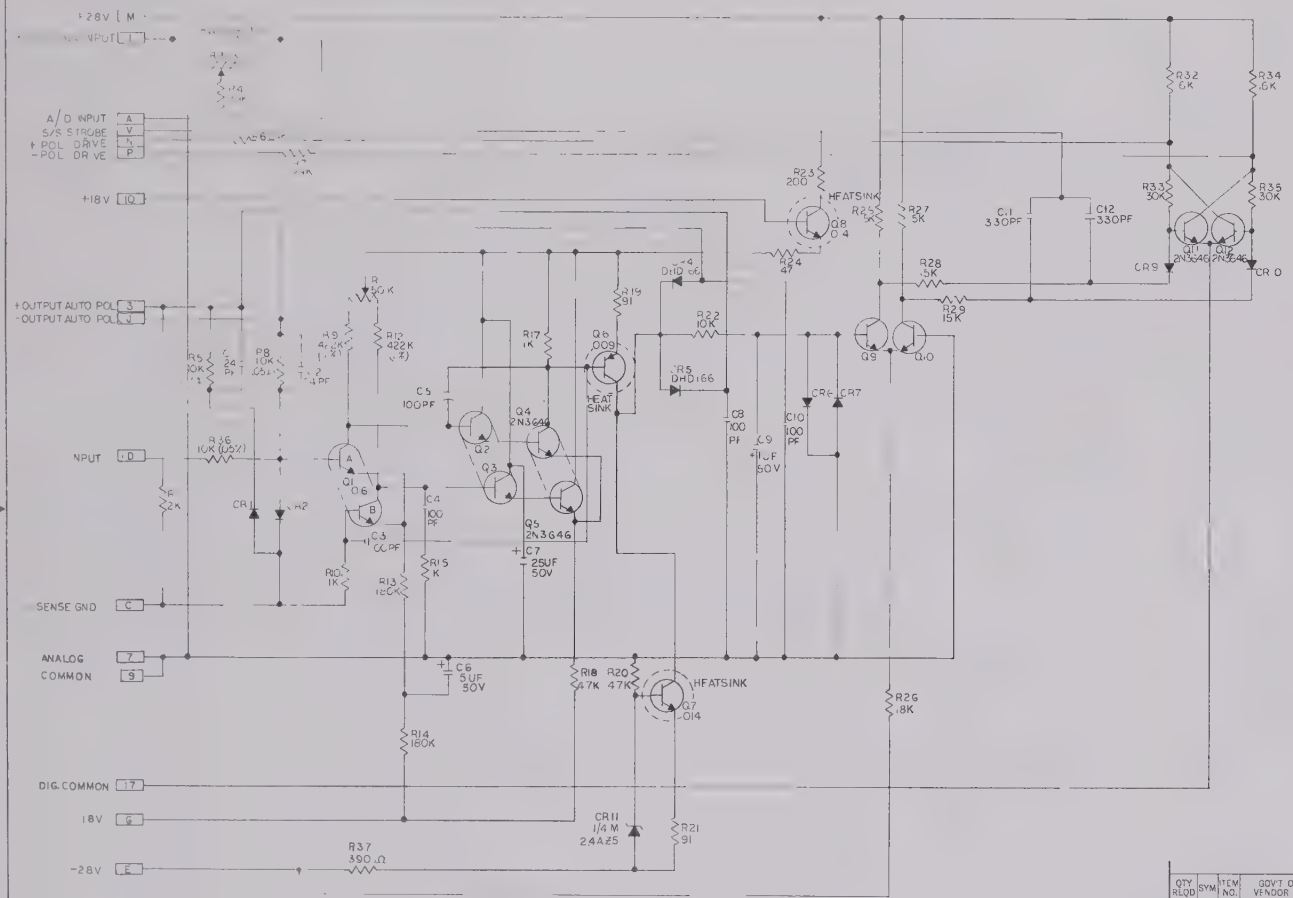
SIZE D | CODE IDENT NO. | DWG NO. 400699 | F

SCALE — | WT — | SHEET 1 OF 1

NOTES. UNLESS OTHERWISE SPECIFIED

1. All resistors are 1/4W, 5% carbon.

2. Heat stamp .10 high black characters and .15 high logo, located as shown.



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

5. Highest numbered reference designators
   R1 thru R37
   C1 thru C11
4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes 1N662

NOTES UNLESS OTHERWISE SPECIFIED

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .032, XX ± .020, XXX ± .010; ANGLES ± 0 30'
FORMED ANGLES = 1.0°
CONCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		
CHK		
APPD		

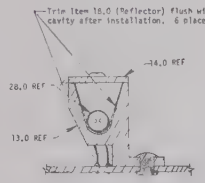
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
AUTO POLARITY

SIZE D | CODE IDENT NO. | DWG NO. 430304

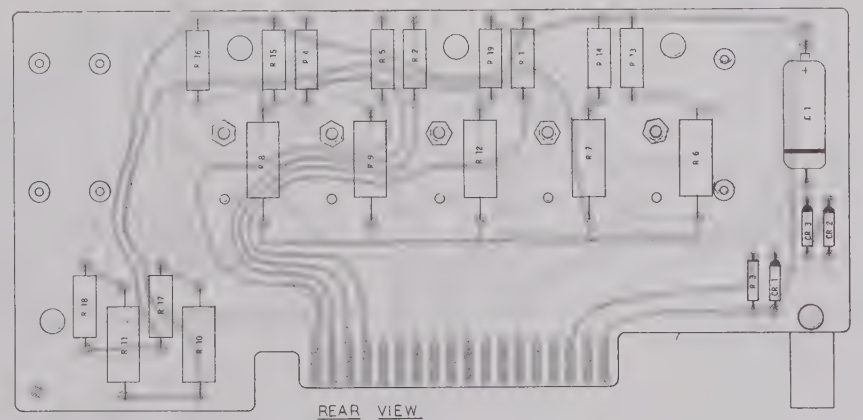
SCALE - | W/T | SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



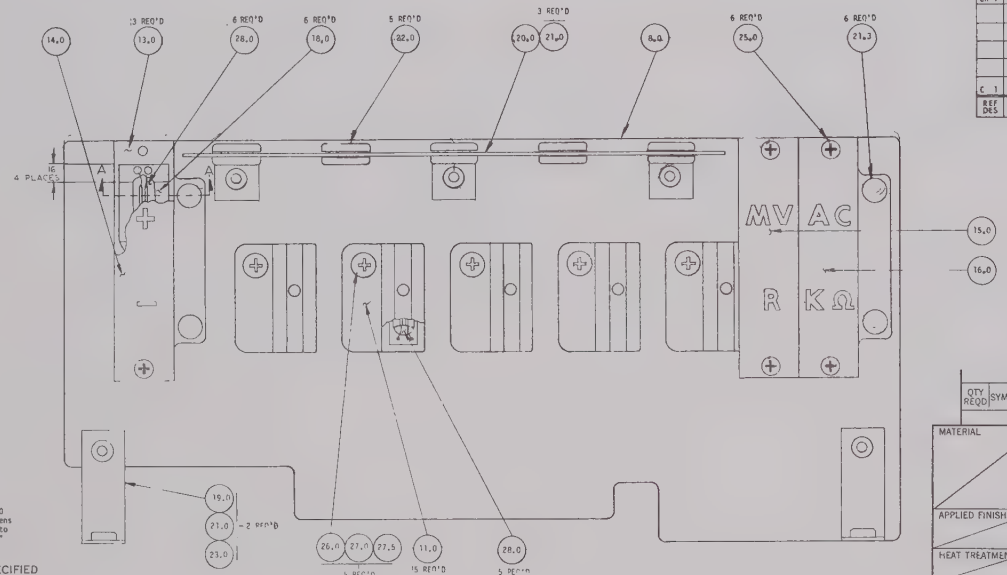
SECTION A-A
TYPICAL 3 PLACES

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
11.0	410183 C.
11.0	450788
13.0	450788
14.0	450873
15.0	450874
16.0	150875
18.0	450876
19.0	450969
20.0	450852
21.0	610032
21.3	617022
22.0	610027
23.0	610111
25.0	610209
26.0	615542
27.0	617017
27.5	617077
28.0	927116



REAR VIEW

P 19 Thru R 13	5.0	100 K 1 W	
R 12 Thru R 6	4.0	100 K 2 W	
P 5	3.0	20 K 1 W	
R 4	2.0	39 K 1 W	
R 3	1.0	220 K 1/4W	
R 2	3.0	20 K 1 W	
R 1	2.0	39 K 1 W	
CR 3 CR 1	7.0	SD 4	
C 1	6.0	250 MFD 6V	
REF DES	B/M ITEM	DESCRIPTION	



2. Indicator tube on Item 11.0 (5 places) and display screens (Item 14.0, 15.0 and 16.0) to be masked before "Hunt-Seal"

1. All neon lamps are NE-2U

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
CONCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		11-9-65
CHK		11-10-65
APPD		

11-9-65

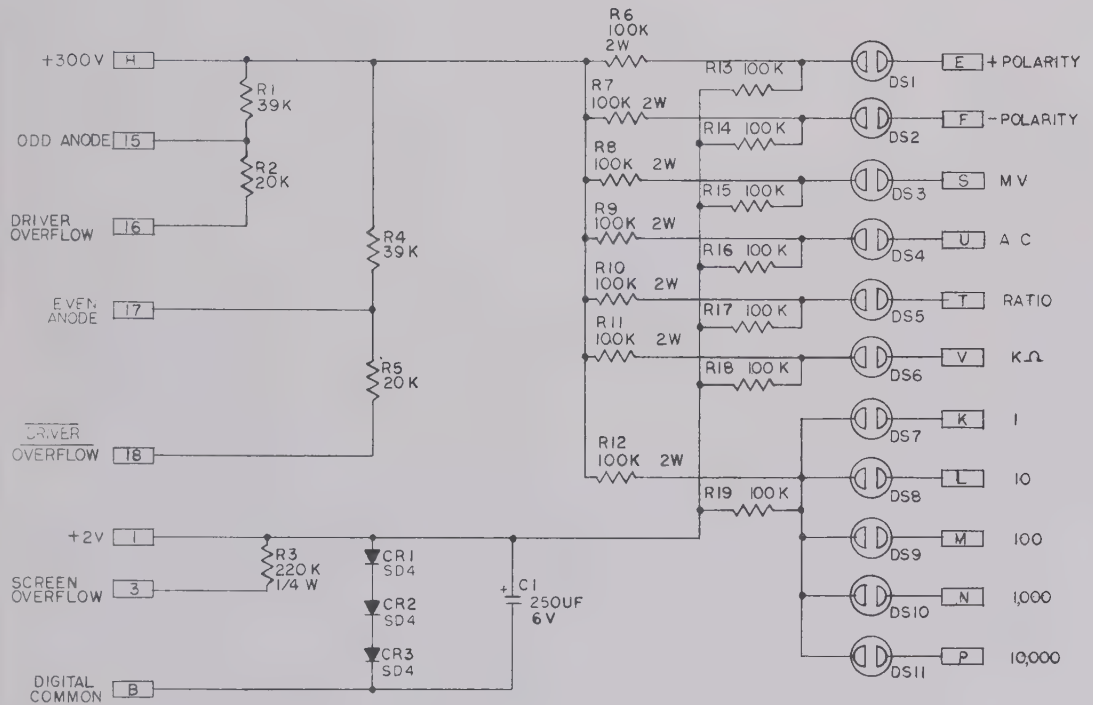
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASS'Y - DISPLAY

SIZE	CODE IDENT NO.	DWG NO.	
D		400691	D

SCALE 2 : 1 | WT | SHEET 1 OF 1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



C 430301

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

3 HIGHEST REFERENCE DESIGNATORS ARE:
R 19
DS 11
CR 3
C 1

2. ALL NEON LAMPS ARE NE-2H
1. ALL RESISTORS 1W, 5%, CARBON
NOTES UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.. SUB ASSY MRA.. MAJOR REPL ASSY
MA.. MODULE ASSY CA.....COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .X ± .030 .XX ± .020 .XXX ± .010
ANGLES ± 0° 30'

MATERIAL
APPLIED FINISH

DRAWN		10-18-65
CHECK		19 OCT 65
ENGR		21 OCT. 65
APPR		

APPROVED
APPROVED
Rel 11-19-65
DRN # 207

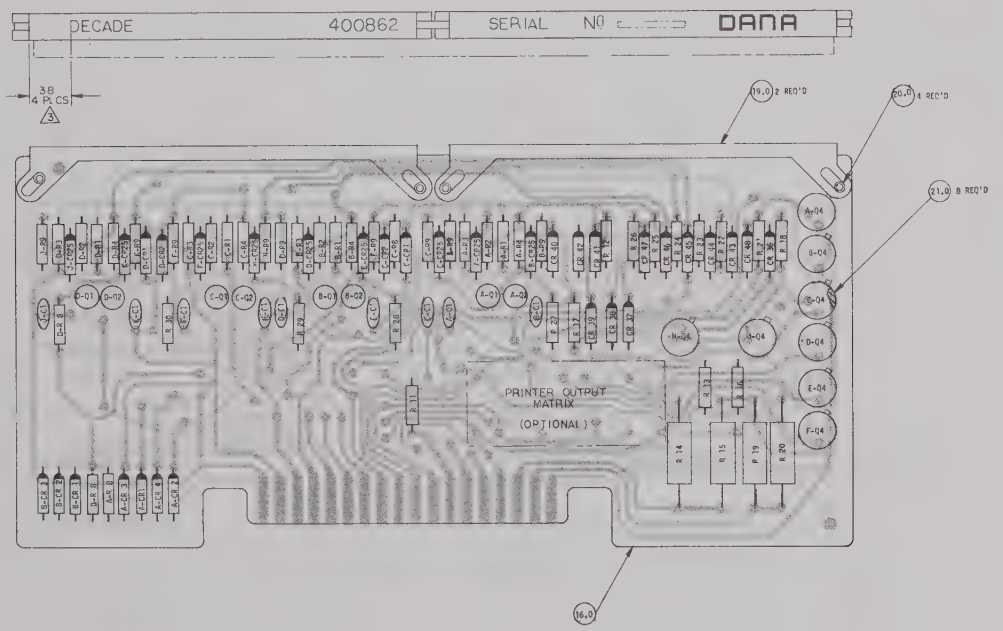
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
DISPLAY

CODE IDENT NO.	SIZE		
	C	430301	C
SCALE	WEIGHT	SHEET 1 OF 1	

586-00 LIETZ 1050 TOPFLIGHT 4-64

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 2	3.0	15 K
D-R3	5.0	2.7 K
D-R1		
C-R3		
C-R1		
B-R3		
B-R1	5.0	2.2 K
A-R3	2.0	1.8 K
A-R1	2.0	1.2 K
Q 4	13.0	014
Q 2	14.0	2N3646
Q 1	14.0	2N3646
CR48	15.0	1N662
THRU		
CR36	15.0	1N662
CR25	15.0	1N662
CR 4	15.0	1N662
CR 3	15.0	1N662
CR 2	15.0	1N662
CR 1	15.0	1N662
C 1	12.0	33 pF

REF DES	B/M ITEM	DESCRIPTION
R 30	6.0	22 K
THRU		
R 27	6.0	22 K
R 26	9.0	33 K
THRU		
R 21	9.0	33 K
R 20	11.0	20 K, 1W
R 19	10.0	39 K, 1W
R 18	1.0	10 K
R 17	1.0	10 K
R 16	1.0	10 K
R 15	10.0	39 K, 1W
R 14	11.0	20 K, 1W
R 13	1.0	10 K
R 12	1.0	10 K
R 11	4.0	200 K
R 9	8.0	27 K
R 8	7.0	24 K
R 4	3.0	15 K

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
16.0	410203
19.0	610236
20.0	610737
21.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

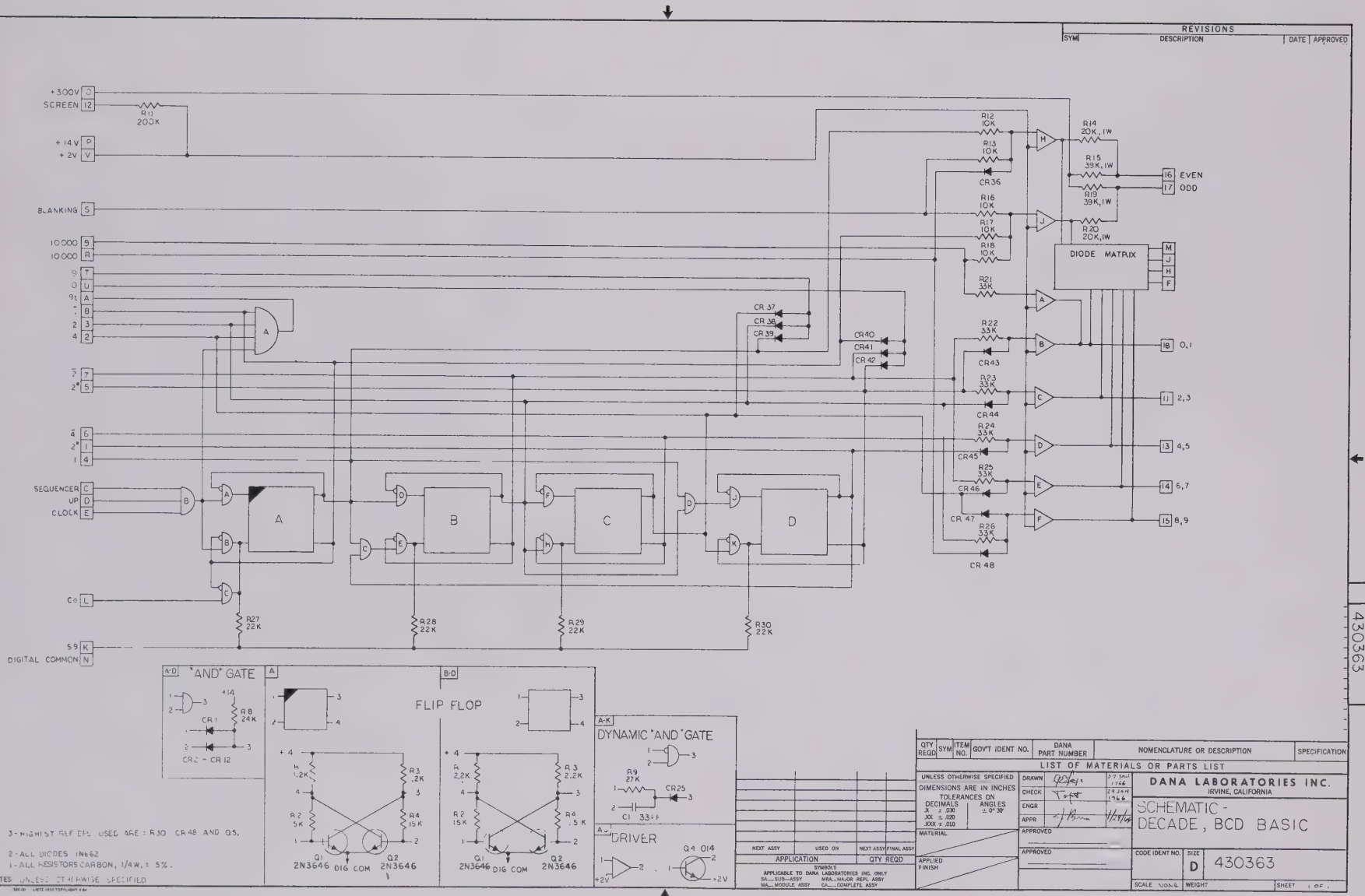
MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH	DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30' FORMED ANGLES ± 1.0° ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327	NAME / DATE DR 29 JAN 1966 CHK 29 JAN 1966 APPD	P.C. BOARD ASS'Y - DECADE, BCD, BASIC
HEAT TREATMENT			SIZE D; CODE IDENT NO —; DWG NO. 400862 SCALE 1/1; WT —; SHEET / OF /

⚠3 Heat stamp .10 high black characters and .15 high logo, located as shown.

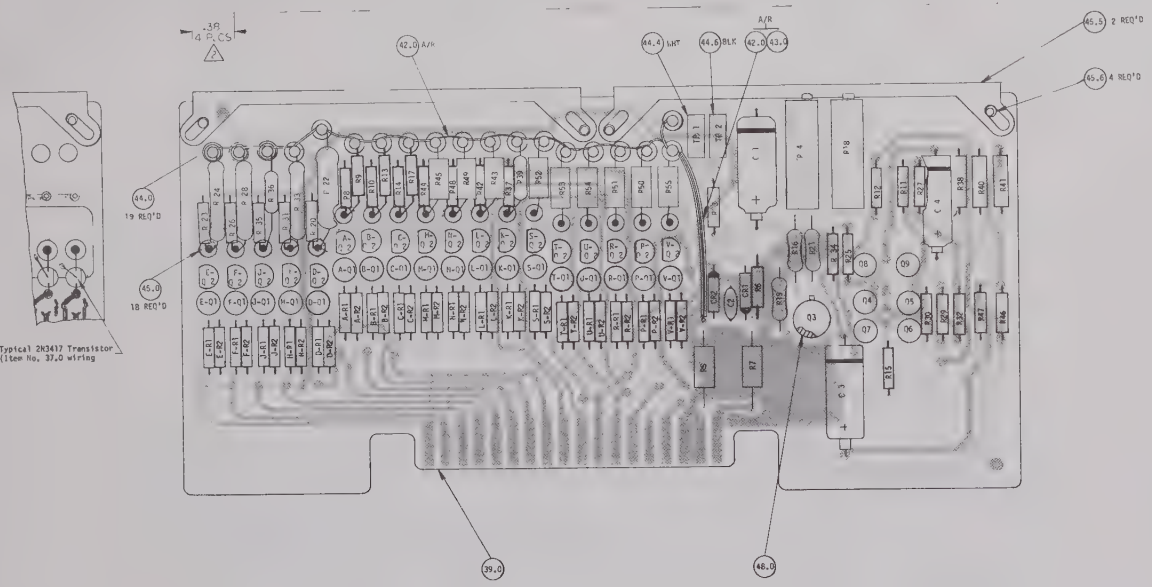
2. Diodes to be 1N662

1. Resistors to be 1/4W, ± 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED


REVISIONS
SYM DESCRIPTION DATE APPROVED
+300V SCREEN
+14V +2V
BLANKING
10000 10000
SEQUENCER UP CLOCK
DIGITAL COMMON
R11 200K
R12 10K
R13 10K
R14 20K,1W
R15 39K,1W
R16 10K
R17 10K
R18 10K
R19 39K,1W
R20 20K,1W
R21 33K
R22 33K
R23 33K
R24 33K
R25 33K
R26 33K
CR36
CR37
CR38
CR39
CR40
CR41
CR42
CR43
CR44
CR45
CR46
CR47
CR48
DIODE MATRIX
EVEN
ODD
0,1
2,3
4,5
6,7
8,9
A
B
C
D
R27 22K
R28 22K
R29 22K
R30 22K
"AND" GATE
FLIP FLOP
DYNAMIC "AND" GATE
DRIVER
R8 24K
CR1
CR2 - CR12
R1 1.2K
R2 5K
R3 2.2K
R4 15K
Q1 2N3646
Q2 2N3646
DIG COM
R9 27K
CR25
C1 33pf
Q4 014
3-HIGHEST REF DES USED ARE: R30 CR48 AND Q5.
2-ALL DIODES IN662
1-ALL RESISTORS CARBON, 1/4W, ± 5%.
NOTES: UNLESS OTHERWISE SPECIFIED
QTY REQD SYM ITEM NO. GOVT IDENT NO. DANA PART NUMBER NOMENCLATURE OR DESCRIPTION SPECIFICATION
LIST OF MATERIALS OR PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030 XX ± .020 XXX ± .010 ANGLES ± 0° 30'
DRAWN CHECK ENGR APPR
MATERIAL
APPLIED FINISH
APPROVED
APPROVED
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC - DECADE, BCD BASIC
CODE IDENT NO. SIZE D 430363
SCALE NONE WEIGHT SHEET 1 OF 1
NEXT ASSY USED ON NEXT ASSY FINAL ASSY
APPLICATION QTY REQD
SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB-ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY
430363

NULL DETECTOR 400843 SERIAL NO DANA



CROSS REFERENCE CHART	
ITEM NO	PART NO
39.0	410207B
42.0	500004
43.0	501376
44.0	500030
44.4	500142
44.6	500144
45.0	500243
45.5	510236
45.6	510237
48.0	520082

REF DES	B/M ITEM	DESCRIPTION
R 24	21.0	5 Meg 1%
R 23	1.0	100K
R 22	20.0	12.5 Meg 1%
R 21	17.0	15 K RN60B
R 20	1.0	100 K
R 19	23.0	154 K 1%
R 18	30.0	POT 2 K E-Z TRIM
R 17	7.0	24 Meg
R 16	17.0	15 K RN60B
R 15	8.0	330 OHMS
R 14	1.0	100K
R 13	7.0	24 Meg
R 12	11.0	4.3 K
R 11	5.0	13 K
R 10	1.0	100 K
R 9	13.0	51 Meg
R 8	1.0	100 K
R 7	25.0	2400.9 OHM .01%
R 6	14.0	680 K
R 5	24.0	4948.22 OHM .01%
R 4	31.0	POT 5 K E-Z TRIM
R 3	1.0	100 K
R 2	9.0	33 K
R 1	12.0	47 K
CR 2	50.0	IN662
CR 1	38.0	IN662
C 4	33.5	1 mfd 50 v
C 3	33.0	25 mfd 50 v
C 2	32.0	220 pf DISC
C 1	33.0	25 mfd 50 v

REF DES	B/M ITEM	DESCRIPTION
V-02	37.2	HIGH ORDER DAC (WHT)
T-V2		
P-02	37.2	HIGH ORDER DAC (WHT)
N-02	37.3	LOW ORDER DAC (YEL)
T-N2		
A-02	37.3	LOW ORDER DAC (YEL)
Q 1	35.0	2N3640
R 55	26.0	49.995 K .01%
R 54	27.0	24.995 K .01%
R 53	27.0	24.995 K .01%
R 50	26.0	49.995 K .01%
R 49	28.0	125 K .05%
R 48	1.0	100 K
R 47	4.0	120 K
R 46	7.5	27 K
R 45	29.0	250 K .05%
R 44	1.0	100 K
R 43	29.0	250 K .05%
R 42	1.0	100 K
R 41	15.0	4.7 K 1/2 W
R 40	16.0	8.2 K 1/2 W
R 39	18.0	500 K .1%
R 38	15.0	4.7 K 1/2 W
R 37	1.0	100 K
R 36	19.0	1.25 Meg 1%
R 35	1.0	100 K
R 34	10.0	330 K
R 33	22.0	2.5 Meg .25%
R 32	3.0	12 K
R 31	1.0	100 K
R 30	2.0	11 K
R 29	6.0	2.4 K
R 28	22.0	2.5 Meg .25%
R 27	3.0	12 K
R 26	1.0	100 K
R 25	10.0	330 K

REF DES	B/M ITEM	DESCRIPTION
Q 9 thru Q 4	36.0	2N3565
Q 3	34.0	Q15

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

Heat Stamp .10 high black characters And .15 high Logo, Located as shown

1. All Resistors 1/4 W, 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, .XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

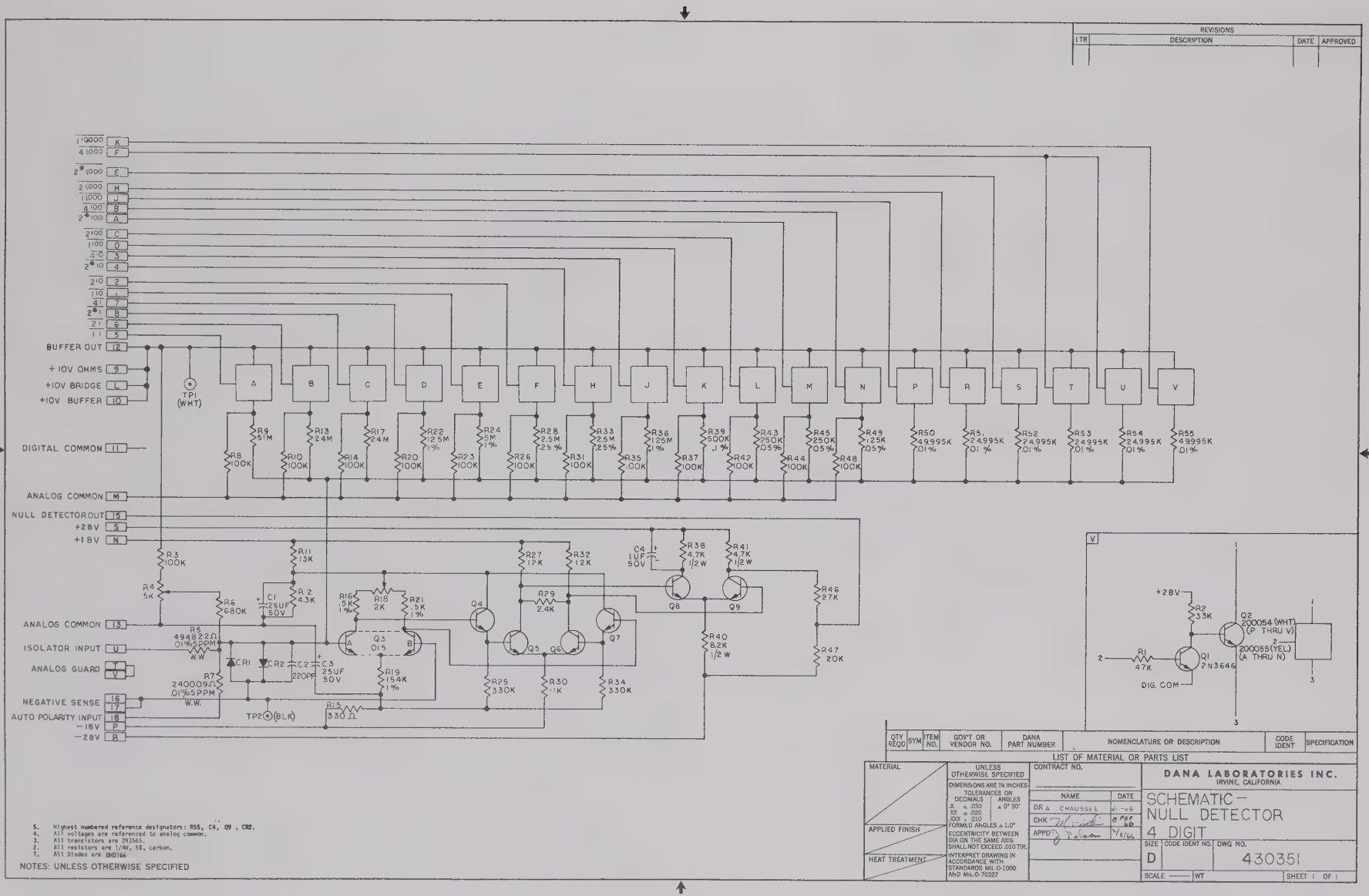
	NAME	DATE
DR		10 FEB 1966
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — NULL DETECTOR, 4 DIGIT

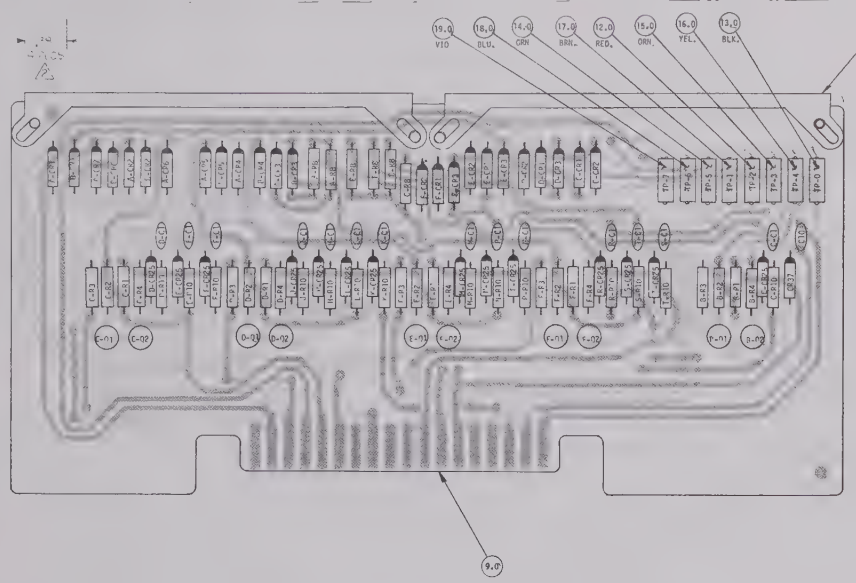
SIZE	CODE IDENT NO.	DWG NO.
D		400843 A

SCALE 2/1 WT — SHEET 1 OF 1


REVISIONS
LTR DESCRIPTION DATE APPROVED
BUFFER OUT
+10V OHMS
+10V BRIDGE
+10V BUFFER
TP1 (WHT)
DIGITAL COMMON
ANALOG COMMON
NULL DETECTOR OUT
+28V
+18V
ANALOG COMMON
ISOLATOR INPUT
ANALOG GUARD
NEGATIVE SENSE
AUTO POLARITY INPUT
-18V
-28V
TP2 (BLK)
+28V
DIG. COM
Q1 2N3646
Q2 200054 (WHT) (P THRU V)
200055 (YEL) (A THRU N)
NOTES: UNLESS OTHERWISE SPECIFIED
1. All Diodes are DHD166
2. All resistors are 1/4W, 5%, carbon.
3. All transistors are 2N3565.
4. All voltages are referenced to analog common.
5. Highest numbered reference designators: R55, C4, Q9, CR2.
LIST OF MATERIAL OR PARTS LIST
QTY REQD | SYM | ITEM NO. | GOV'T OR VENDOR NO. | DANA PART NUMBER | NOMENCLATURE OR DESCRIPTION | CODE IDENT | SPECIFICATION
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327
CONTRACT NO.
NAME DATE
DR A CHAUSSEE 2-16-66
CHK 8 FEB 66
APPD 2/8/66
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC — NULL DETECTOR 4 DIGIT
SIZE D
CODE IDENT NO.
DWG NO. 430351
SCALE — WT
SHEET 1 OF 1

SEQUENCE LOGIC 400688 SERIAL NO [illegible] DANA

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
B-P3	6.0	8.2 K
B-R1	6.0	8.2 K
Q 2	8.0	2N3646
Q 1	8.0	2N3646
R 10	5.0	27 K
R 8	0.7	12 K
R 4	1.0	15 K
R 3	3.0	2.2 K
R 2	1.0	15 K
R 1	3.0	2.2K
CR 25	8.5	1N662
CR 7	8.5	1N662
CR 1	8.5	1N662
C 10	7.5	280 PF
C 1	7.0	33 PF

CROSS REFERENCE CHART	
ITEM NO	PART NO
9.0	610155 A
12.0	600143
13.0	600144
14.0	600145
15.0	600146
16.0	600147
17.0	600148
18.0	600149
19.0	600150
19.5	610236
19.6	610237

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

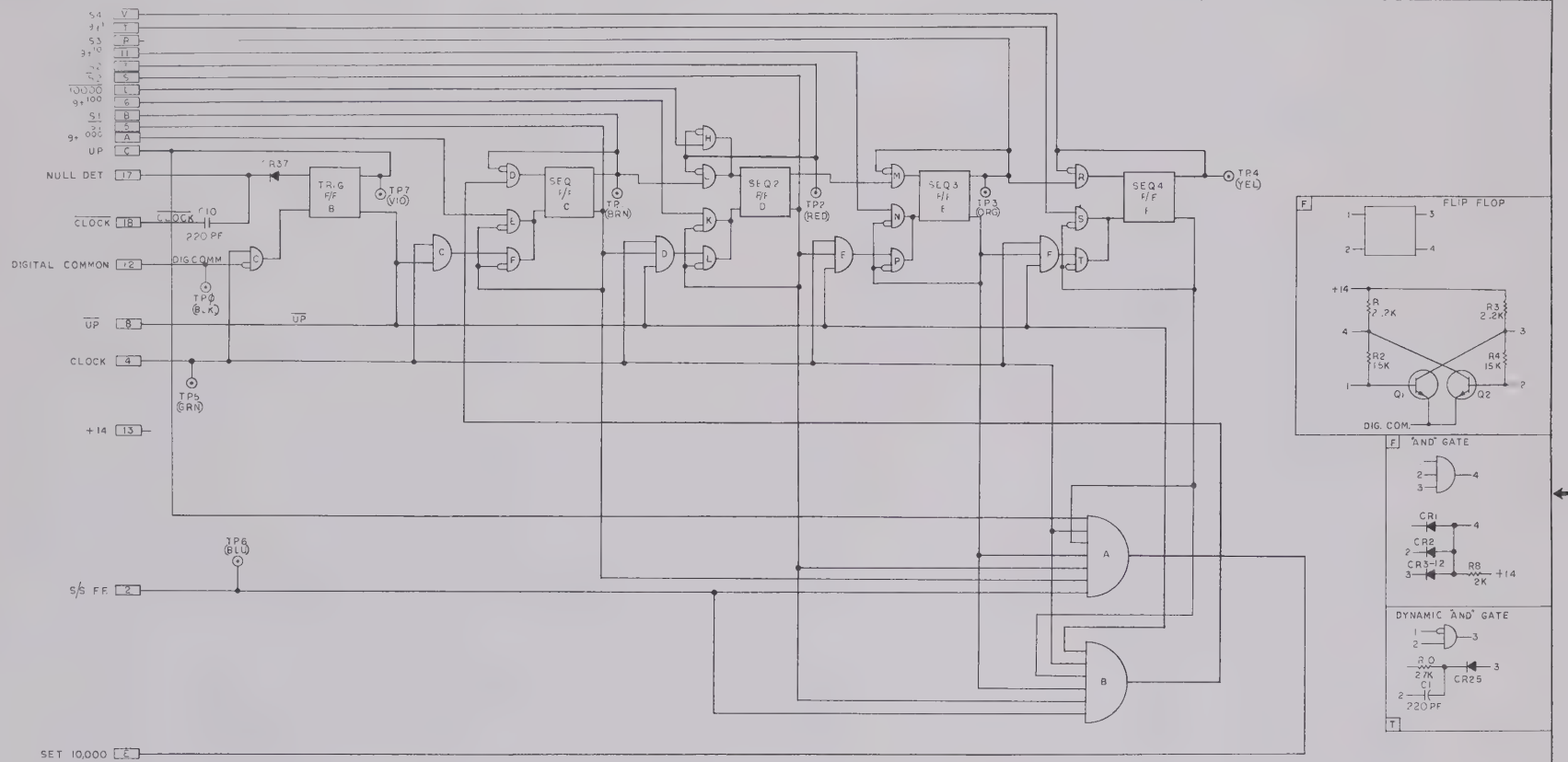
LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH	DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'; FORMED ANGLES ± 1.0° ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.	NAME / DATE: DR [illegible] 11-6-; CHK [illegible] 11-7-; APPD [illegible]	PC BOARD ASS'Y SEQUENCE LOGIC
HEAT TREATMENT	INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS M-D-1000 AND MIL-D-70327		SIZE D; CODE IDENT NO.; DWG NO. 400688; C; SCALE 2:1; WT; SHEET 1 OF 1

⚠ Heat stamp .10 high black characters and .15 high logo, located as shown.

1. All resistors 1/4W, 5% carbon

NOTES: UNLESS OTHERWISE SPECIFIED



7. * Resistors R 1 & R 3 in Trigger F.F. "B" are 8.2 K, 1/4W, 5%, Carbon
6. Highest lettered referenced designator for logic elements is shown in upper left hand corner of logic schematics
5. Highest numbered reference designators:
   R 35 D 11
   C 10 CR 39
4. All voltages referenced to digital common
3. All transistors MPS 2N3646
2. All resistors 1/4w, 5%, Carbon
1. All diodes 1N662

NOTES UNLESS OTHERWISE SPECIFIED

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS | ANGLES
.X ± .030 | ± 0° 30'
.XX ± .020
.XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D 1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		3 JAN 1968
CHK	R. Fisher	
APPD		1/4/68

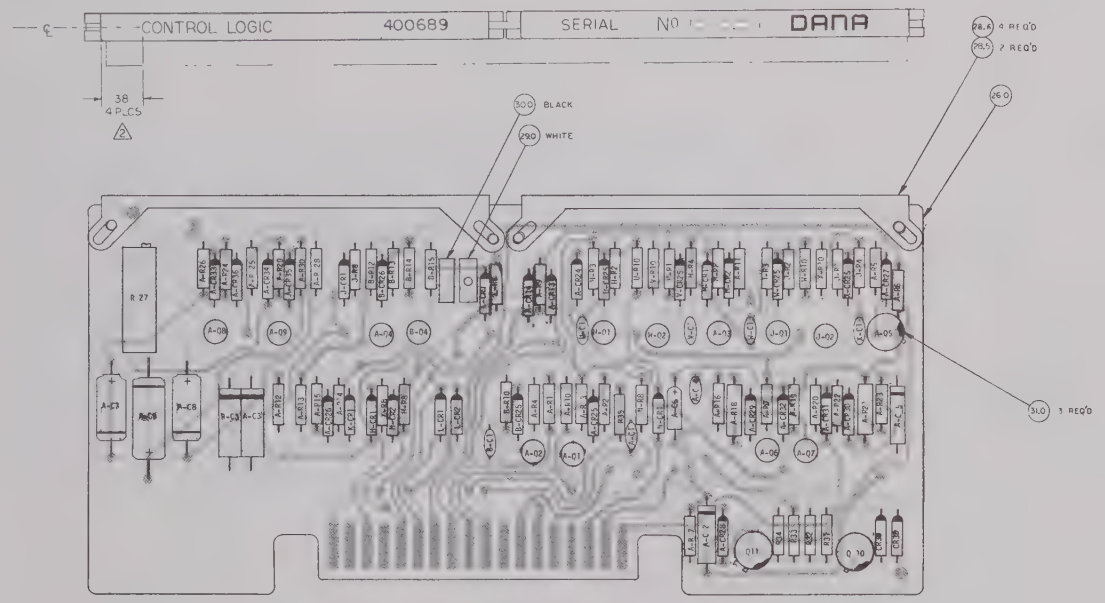
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — SEQUENCE LOGIC, MODEL 5400 DVM

SIZE	CODE IDENT NO.	DWG NO.
D		430348

SCALE —— | WT | SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
R 1	8.0	2.2K
Q 11	23.0	014
Q 10	23.0	014
Q 9	24.0	2N3646
↑	↑	↑
Thru		
↓	↓	↓
Q 6	24.0	2N3646
Q 5	22.0	009
Q 4	24.0	2N3646
↑	↑	↑
Thru		
↓	↓	↓
Q 1	24.0	2N3646
CR36	25.0	1N662
↑	↑	↑
Thru		
↓	↓	↓
CR 1	25.0	1N662
C 9	19.0	25 MFD 25 V
C 8	18.0	5.0 MFD 50 V
C 7	18.0	5.0 MFD 50 V
C 6	17.0	1 MFD 35 V
C 5	19.5	.0018 MFD 100 V
C 4	16.5	.001 MFD DISC
C 3	21.3	.022MFD 100 V
C 2	21.5	.0015 MFD 100 V
C 1	13.0	33 PF

REF DES	B/M ITEM	DESCRIPTION
R 35	13.0	8.2 K
R 34	1.0	10 K
↑	↑	↑
Thru		
↓	↓	↓
R 31	1.0	10 K
R 30	1.0	27K
R 29	2.0	100 K
R 28	8.0	2.2 K
R 27	14.5	20 K (POT)
R 26	4.5	3 K
R 25	8.0	2.2 K
R 24	2.0	100 K
R 23	5.0	15 K
R 22	2.0	100 K
R 21	16.0	1.2 K 1/2W 5%
R 20	7.0	20 K
R 19	7.0	20 K
R 18	16.0	1.2 K 1/2W 5%
R 17	2.0	100 K
R 16	5.0	15 K
R 15	2.0	100 K
R 14	13.0	8.2 K
R 13	5.0	15 K
R 12	10.0	24 K
R 11	6.0	200 ohms
R 10	11.0	27 K
R 9	7.5	200 K
R 8	13.0	12 K
R 7	9.0	2.4 K
R 6	5.0	15 K
R 5	12.0	6.2 K
R 4	5.0	15 K
R 3	8.0	2.2K
R 2	5.0	15 K

CROSS REFERENCE CHART	
ITEM NO.	PART NO
26.0	410156.C
28.5	610236
28.6	610237
29.0	600142
30.0	600144
31.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL / APPLIED FINISH / HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND Mil. D-70327

CONTRACT NO.

	NAME	DATE
DR	W. Eng	4 NOV 1965
CHK	[illegible]	[illegible]
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY-
CONTROL LOGIC

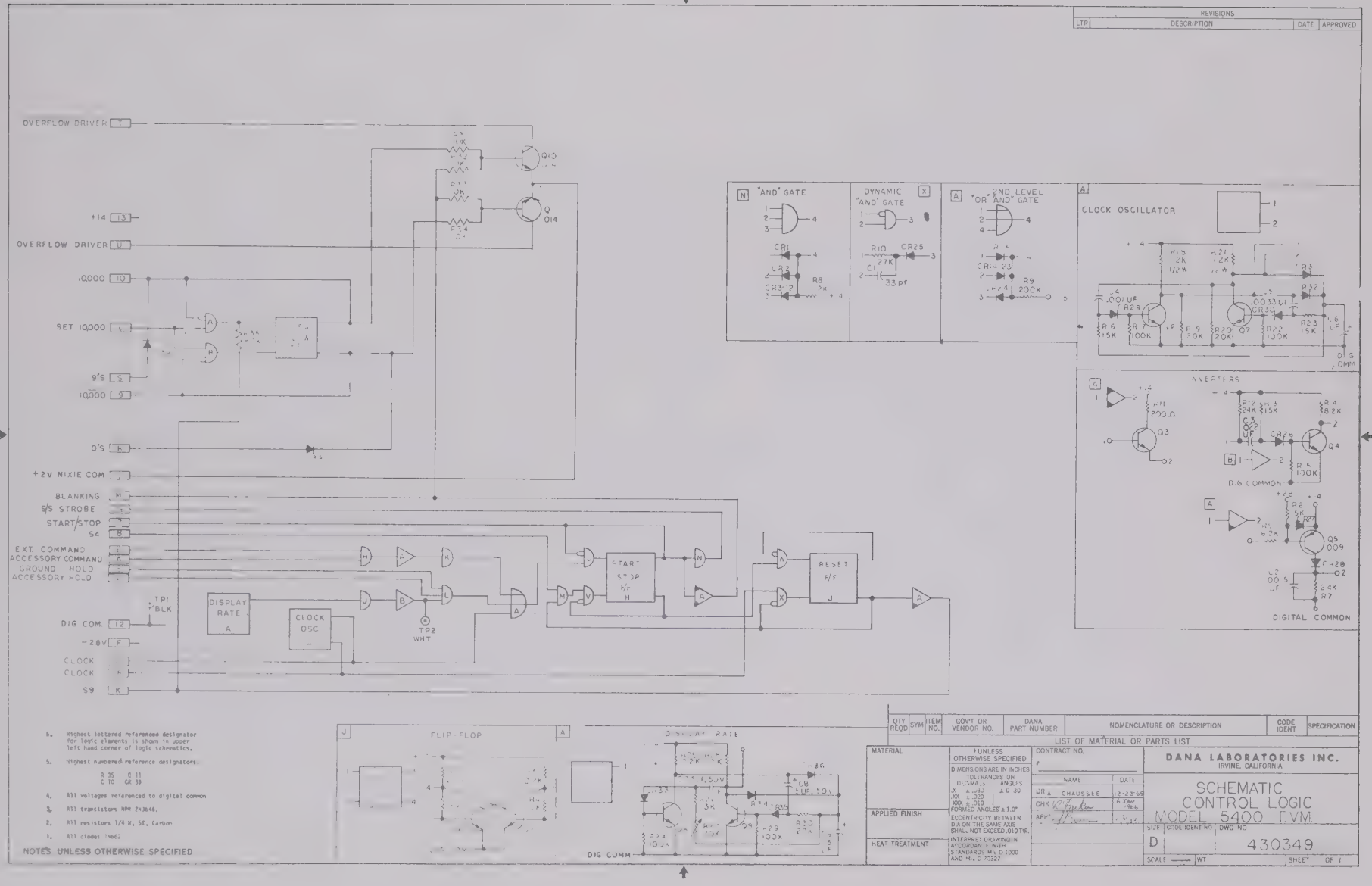
SIZE	CODE IDENT NO.	DWG NO.	
D	—	400689	C

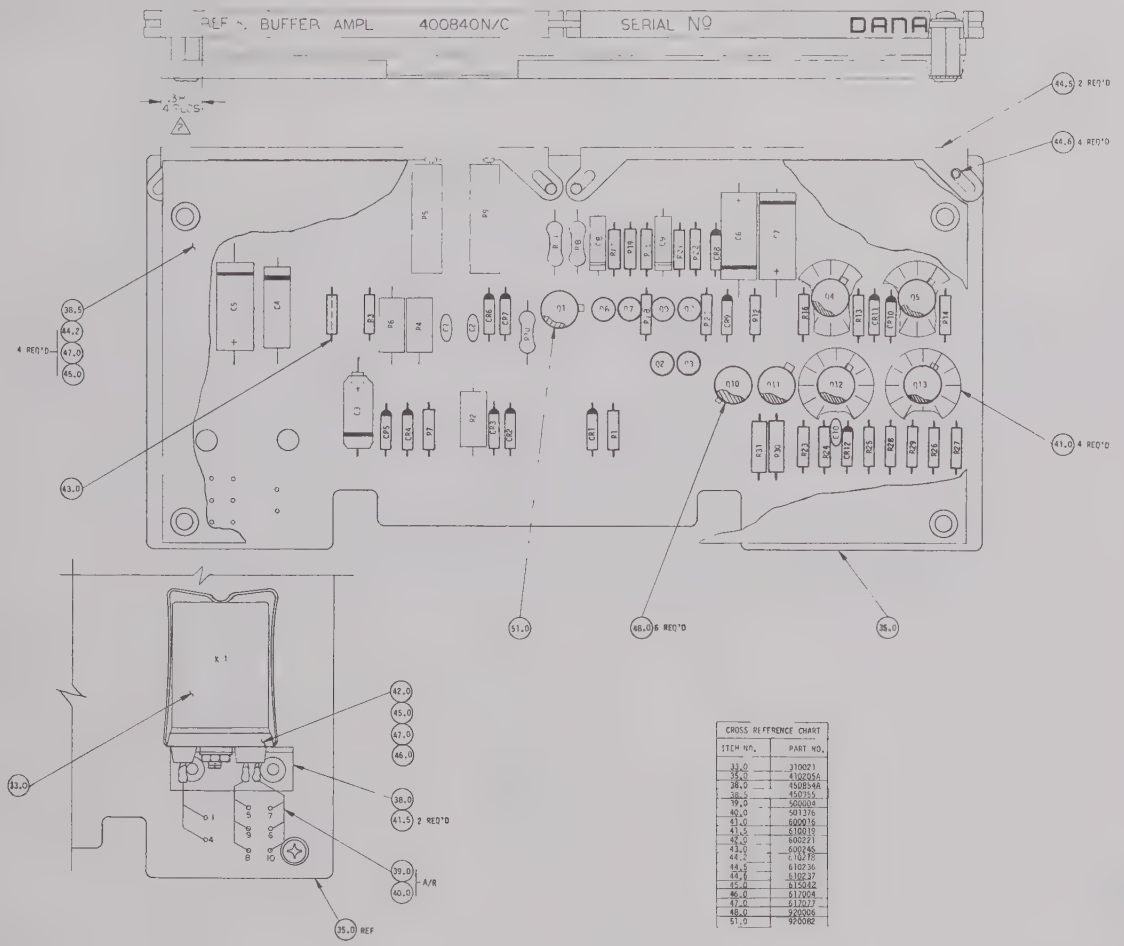
SCALE 2/1 | WT — | SHEET 1 OF 1

2 HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.

1. RESISTORS TO BE 1/4 WATT, ±5% CARBON

NOTES: UNLESS OTHERWISE SPECIFIED


REVISIONS
LTR DESCRIPTION DATE APPROVED
OVERFLOW DRIVER
+14
OVERFLOW DRIVER
10,000
SET 10,000
9'S
10,000
0'S
+2V NIXIE COM
BLANKING
S/S STROBE
START/STOP
S4
EXT. COMMAND
ACCESSORY COMMAND
GROUND HOLD
ACCESSORY HOLD
DIG COM.
-28V
CLOCK
CLOCK
S9
TP1 BLK
TP2 WHT
DISPLAY RATE A
CLOCK OSC
START STOP F/F H
RESET F/F J
"AND" GATE
DYNAMIC "AND" GATE
2ND LEVEL "OR" "AND" GATE
CLOCK OSCILLATOR
INVERTERS
D.G COMMON
DIGITAL COMMON
FLIP-FLOP
DISPLAY RATE
DIG COMM
NOTES UNLESS OTHERWISE SPECIFIED
1. All resistors 1/4 W, 5%, Carbon
2. All transistors NPN 2N3646.
3. All voltages referenced to digital common
4. All diodes 1N662
5. Highest numbered reference designators.
R 35 C 11
C 10 CR 39
6. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics.
QTY REQD
SYM
ITEM NO.
GOVT OR VENDOR NO.
DANA PART NUMBER
NOMENCLATURE OR DESCRIPTION
CODE IDENT
SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS ANGLES
X ±.032 ±0 30'
XX ±.020
XXX ±.010
FORMED ANGLES ±1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327
CONTRACT NO.
NAME DATE
DR A CHAUSSEE 12-23-68
CHK
APVL
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC
CONTROL LOGIC
MODEL 5400 CVM
SIZE D
CODE IDENT NO
DWG NO 430349
SCALE
WT
SHEET OF 1



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

REF DES	B/M ITEM	DESCRIPTION
R8	14.0	200 K, 1%
R7	12.3	680 ohms
R6	34.0	FSV,6.10-6.38 K, .1%
R5	16.0	POT - 5 K, E-Z TRIM
R4	34.0	FSV,3.55-3.83 K, .1%
R3	6.0	24 ohms
R2	34.0	FSV,200-1000 ohm, 1%
R1	11.0	5.1 K
CR12	30.0	1N662
CR11	30.0	1N662
CR10	30.0	1N662
CR9	32.0	1N958B
CR8	32.0	1N958B
CR7	30.5	007
CR6	30.5	007
CR5	30.0	1N662
CR4	30.0	1N662
CR3	34.0	FSV, BRIDGE ELEMENT
CR2	30.5	007
CR1	31.0	1N751
C10	20.0	100 pf, DISC
C9	23.0	.001 uf, 100V
C8	23.0	.001 uf, 100V
C7	21.0	25 uf, 50V
C6	21.0	25 uf, 50V
C5	21.0	25 uf, 50V
C4	24.0	.047 uf 100V
C3	22.0	1 uf, 50V
C2	19.5	150 pf, DISC
C1	18.9	330 pf, DISC

REF DES	B/M ITEM	DESCRIPTION
Q 13	25.0	009
Q 12	26.0	014
Q 11	26.0	014
Q 10	25.0	009
Q 9	28.0	2N3565
Q 6	28.0	2N3565
Q 5	26.0	014
Q 4	25.0	009
Q 3	28.0	2N3565
Q 2	28.0	2N3565
Q 1	27.0	016
R31	13.0	3.3 K, 1/2 W
R30	13.0	3.3 K, 1/2 W
R29	6.0	24 ohms
R28	6.0	24 ohms
R27	8.0	27 K
R26	5.0	2.2 K
R25	2.0	1 K
R24	10.0	47 K
R23	2.0	1 K
R22	7.0	2.4 K
R21	3.0	1 MEG
R20	11.5	6.2 K
R19	9.0	36 K
R18	11.5	6.2 K
R17	3.0	1 MEG
R16	1.0	100 ohms
R15	7.0	2.4 K
R14	8.0	27 K
R13	1.0	100 ohms
R12	4.0	1.2 K
R11	14.0	200 K, 1%
R10	15.0	182 K, 1%
R9	17.0	POT - 50 K,E-Z TRIM

CROSS REFFRENCE CHART	
ITEM NO.	PART NO.
33.0	310021
34.0	410205A
36.0	450848
38.5	450755
39.0	500004
40.0	501376
41.0	600016
41.5	610010
42.0	600221
43.0	600245
44.2	610215
44.5	610236
44.6	610237
45.0	615042
46.0	617004
47.0	617027
48.0	920006
51.0	920068

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		1 JUL 1968
CHK		2 AUG 1968
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY - REFERENCE & BUFFER AMPLIFIER

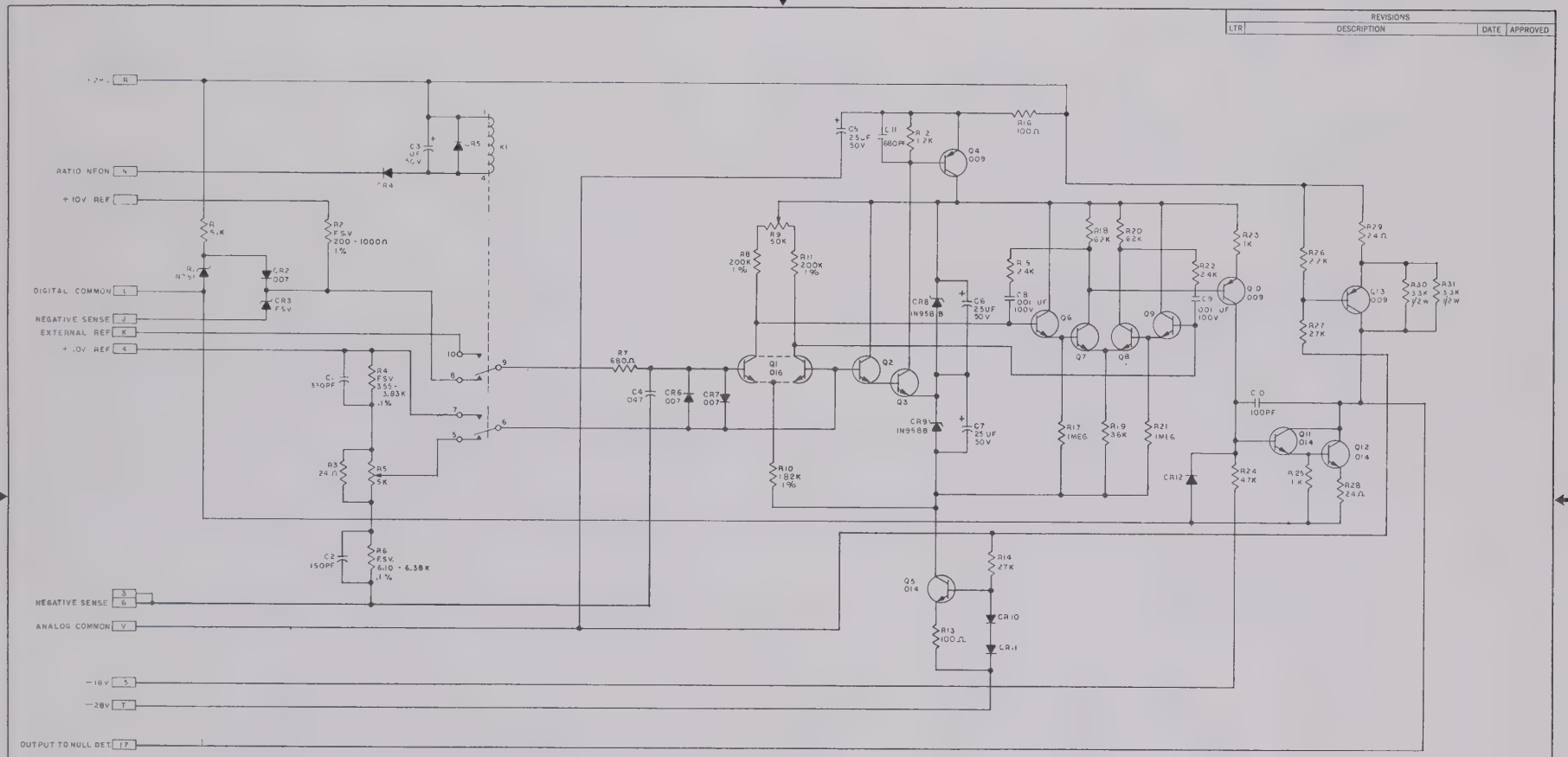
SIZE D | CODE IDENT NO. | DWG NO. 400840

SCALE 2/1 | WT | SHEET 1 OF 1

2. Heat stamp .10 high black characters and .15 high logo, located as shown.

1. All resistors 1/4 W, ±5%, carbon.

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

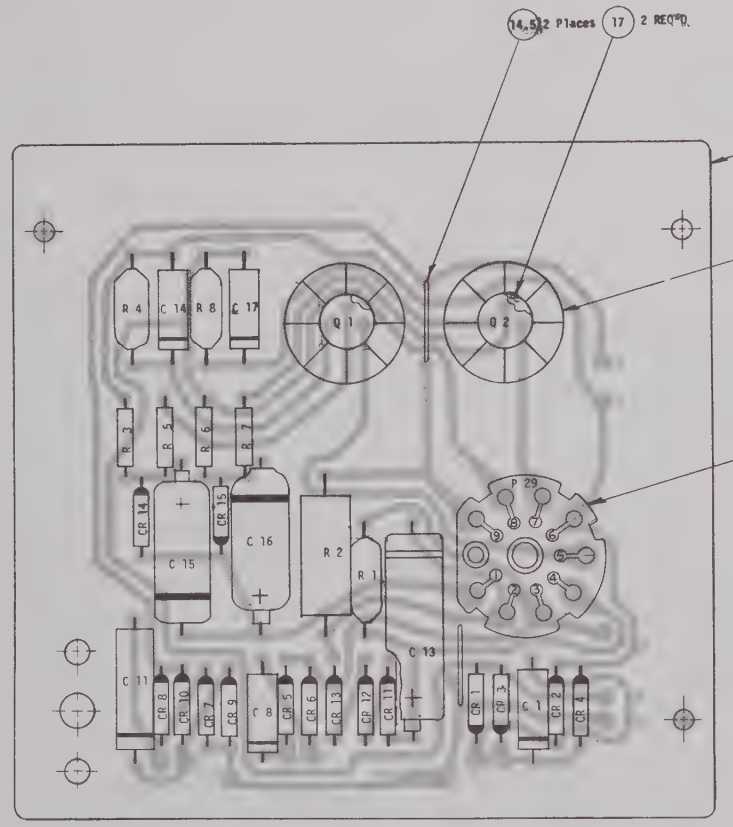
LIST OF MATERIAL OR PARTS LIST

5. Relay shown in de-energized position
4. Highest numbered reference designators
   R31 Q13
   C11 CR12
3. All transistors, 2N3565
2. All resistors, 1/4W, 5%, Carbon
1. All diodes 1N662

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH	DIMENSIONS ARE IN INCHES. TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'. FORMED ANGLES ± 1.0°. ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327	NAME / DATE: DR A CHAUSSEE 1-10-66; CHK [illegible] Jan 66; APPD [illegible] 1-13-66	SCHEMATIC REFERENCE & BUFFER AMPLIFIER
HEAT TREATMENT			SIZE D; CODE IDENT NO.; DWG NO. 430350 A; SCALE —; WT; SHEET 1 OF 1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



REF DES	B/M ITEM	DESCRIPTION
CR15	12.0	1N967B
CR14	12.0	1N967B
CR13	11.0	SD-4
↕	↕	↕
THRU		
↕	↕	↕
CR 1	11.0	SD-4
C 17	8.5	.01 MFD, 100 V
C 16	6.0	25 MFD, 50 V
C 15	6.0	25 MFD, 50 V
C 14	8.5	.01 MFD, 100 V
C 13	7.0	250 MFD, 6 V
C 11	8.0	.01 MFD, 600 V
C 8	8.5	.01 MFD, 100 V
C 1	8.5	.01 MFD, 100 V

REF DES	B/M ITEM	DESCRIPTION
R 8	3.0	150 ohm, 3 W
R 7	1.0	150 ohm
R 6	2.0	2 K
R 5	1.0	150 ohm
R 4	3.0	150 ohm, 3 W
R 3	2.0	2 K
R 2	5.0	220 K, 2 W
R 1	4.0	200 ohm, 3 W
Q 2	9.0	009
Q 1	10.0	014

CROSS REFERENCE CHART	
ITEM NO.	PART NUMBER
13.0	4101643
14.5	500004
15.0	600016
16.0	600234
17.0	920006

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY

APPLICATION — QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.....SUB—ASSY MRA.....MAJOR REPL ASSY
MA.....MODULE ASSY CA.....COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, .XX ± .020, .XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN	W. Edie	13 Oct 1965
CHECK	Toft	13 Oct 1965
ENGR	Joe Brace	10/14/65
APPR		

APPROVED

APPROVED

Per 11-17-65 DRN #200

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y- POWER SUPPLY

CODE IDENT NO.	SIZE	
———	C	400707 B
SCALE 2/1	WEIGHT ———	SHEET 1 OF 1

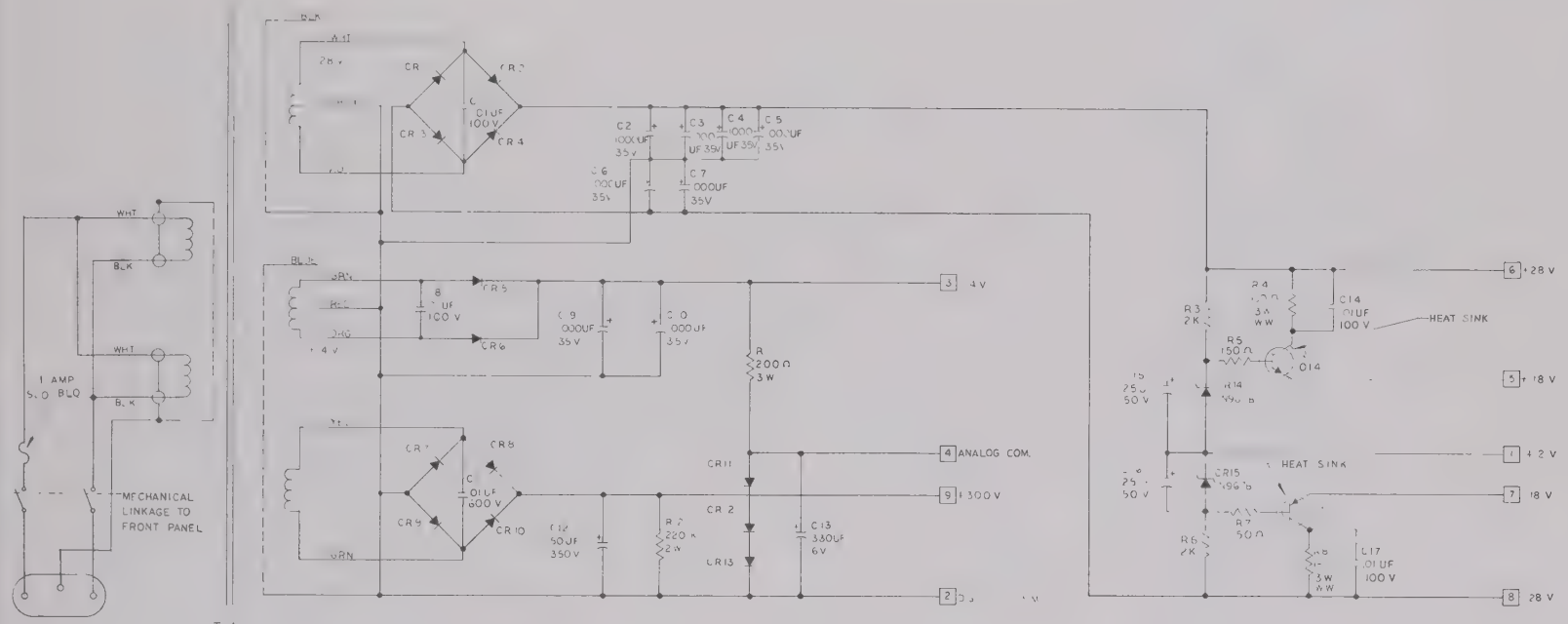
B | 400707

1. Resistors to be 1/4W, ± 5%, carbon.

NOTES: UNLESS OTHERWISE SPECIFIED

586-00 LIETZ 1030 TOPFLIGHT 4-64

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
N/C	RELEASED TO PRODUCTION PILOT	1/26/68	



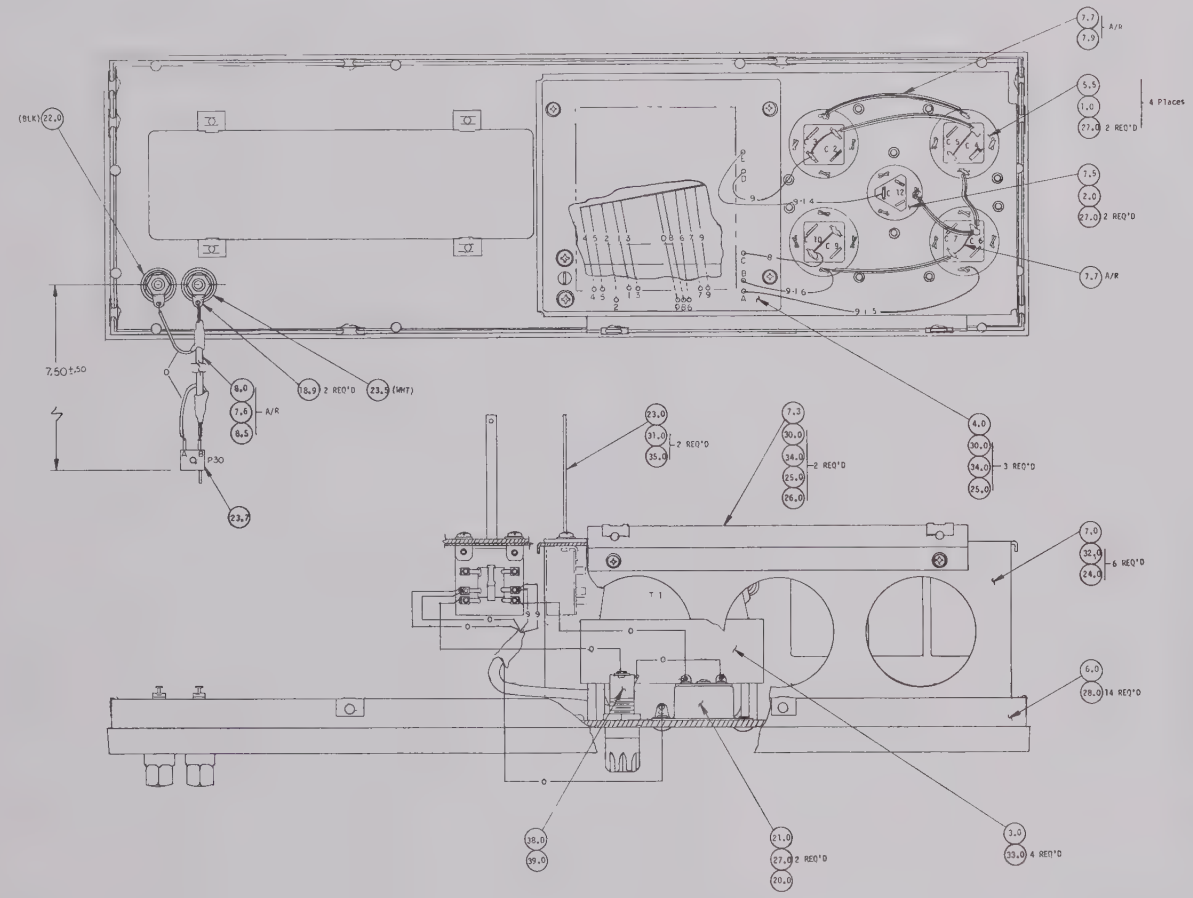
QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES; TOLERANCES ON DECIMALS X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'; FORMED ANGLES ± 1.0°; ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED 0.10 T.I.R.; INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH		NAME / DATE: DRAWN MACLEE 1/26; CHK; APPD	SCHEMATIC — POWER SUPPLY
HEAT TREATMENT			SIZE D; CODE IDENT NO.; DWG NO. 430318; SCALE; WT; SHEET 1 OF 1

NOTES UNLESS OTHERWISE SPECIFIED

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
1.0	300009 A
4.0	400707 A
5.5	450186
5.0	450810 A
7.0	450821 D
7.5	450888
7.5	450918
7.6	500002
7.7	500004
7.9	501376
8.0	501446
8.5	524000
13.0	524914
13.0	524915
15.0	574916
18.5	524888
18.8	524999
18.5	600026
20.0	600032
21.0	600126
22.0	600230
23.0	600235
23.5	600244
23.7	600257
26.0	610101
26.0	610111
26.0	610130
27.0	610138
28.0	610195
30.0	615042
31.0	615057
32.0	615557
33.0	615573
34.0	617077
35.0	617079
38.0	920093
39.0	921539

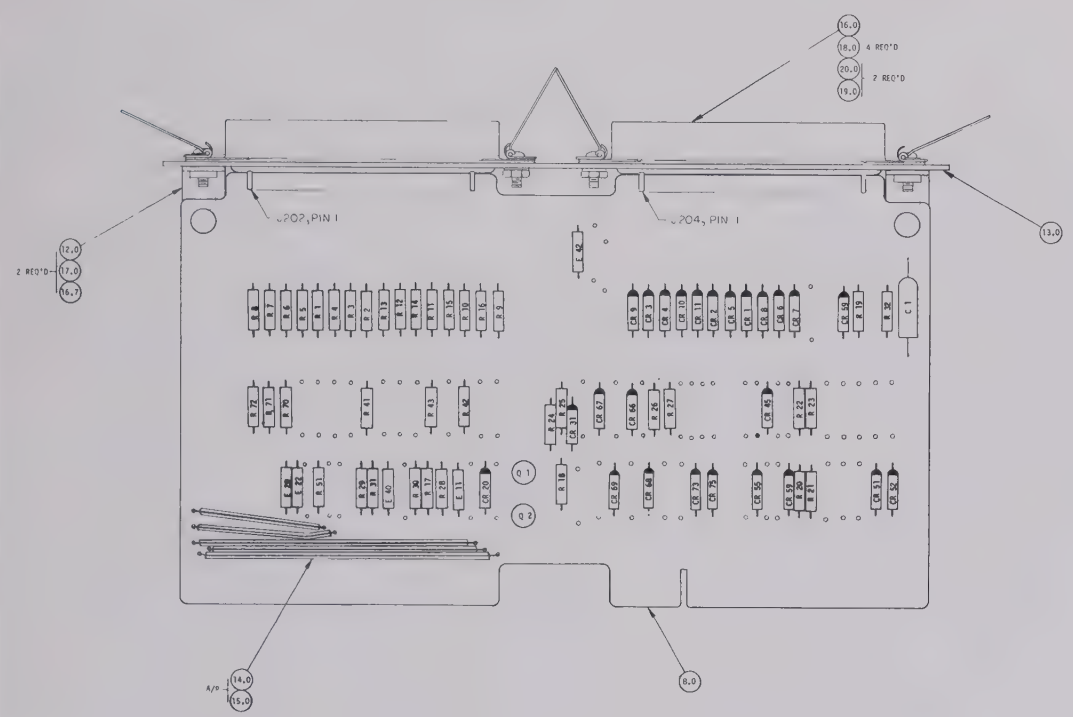
C 12	2.0	50 MFD 350V
C 10		
C 9	1.0	1000 MFD 35V (DUAL)
C 7		
C 6	1.0	1000 MFD 35V (DUAL)
C 5		
C 4	1.0	1000 MFD 35V (D.A.)
C 3		
C 2	1.0	1000 MFD 35V (DUAL)
REF DES	B/M ITEM	DESCRIPTION

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL: SEE L/M	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'. FORMED ANGLES ± 1.0°. ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH		NAME / DATE: DR [illegible] 10/26/66; CHK [illegible] 10/26/66; APPD [illegible] 11/1/66	REAR PANEL ASSY - 5400
HEAT TREATMENT			SIZE D; CODE IDENT NO —; DWG NO. 400684 A; SCALE 1/1; WT —; SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED



REF DES	B/M ITEM	DESCRIPTION
E 42	16.5	Jumper - 600245
E 40		
E 22		
E 20		
E 11	16.5	Jumper - 600245
R 72	1.0	1 K
R 71	6.0	6.8 K
R 70	1.0	1 K
R 51	3.0	47 K
R 43	3.0	47 K
R 42	3.0	47 K
R 41	3.0	47 K
R 32	.5	100ohms
R 31	5.0	8.2 K
R 30	2.0	15 K
R 29	5.0	8.2 K
R 28	2.0	15 K
R 27	3.0	47 K
Thru		
R 1	3.0	47 K
Q 2	6.0	2N3646
Q 1	6.0	2N3646
CR75	7.0	1N662
Thru		
CR 1	7.0	1N662
C 1	5.5	6.8 uF/35V

GROSS REFERENCE CHART	
ITEM NO.	PART NO.
8.0	410220A
12.0	450848A
13.0	450891A
14.0	500004
15.0	501376
16.0	600017
16.7	610138
17.0	610216
18.0	615030
19.0	617003
20.0	617076

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D-70327

CONTRACT NO.

	NAME	DATE
DR		3 MAY
CHK		5 MAY
APPD		5/66

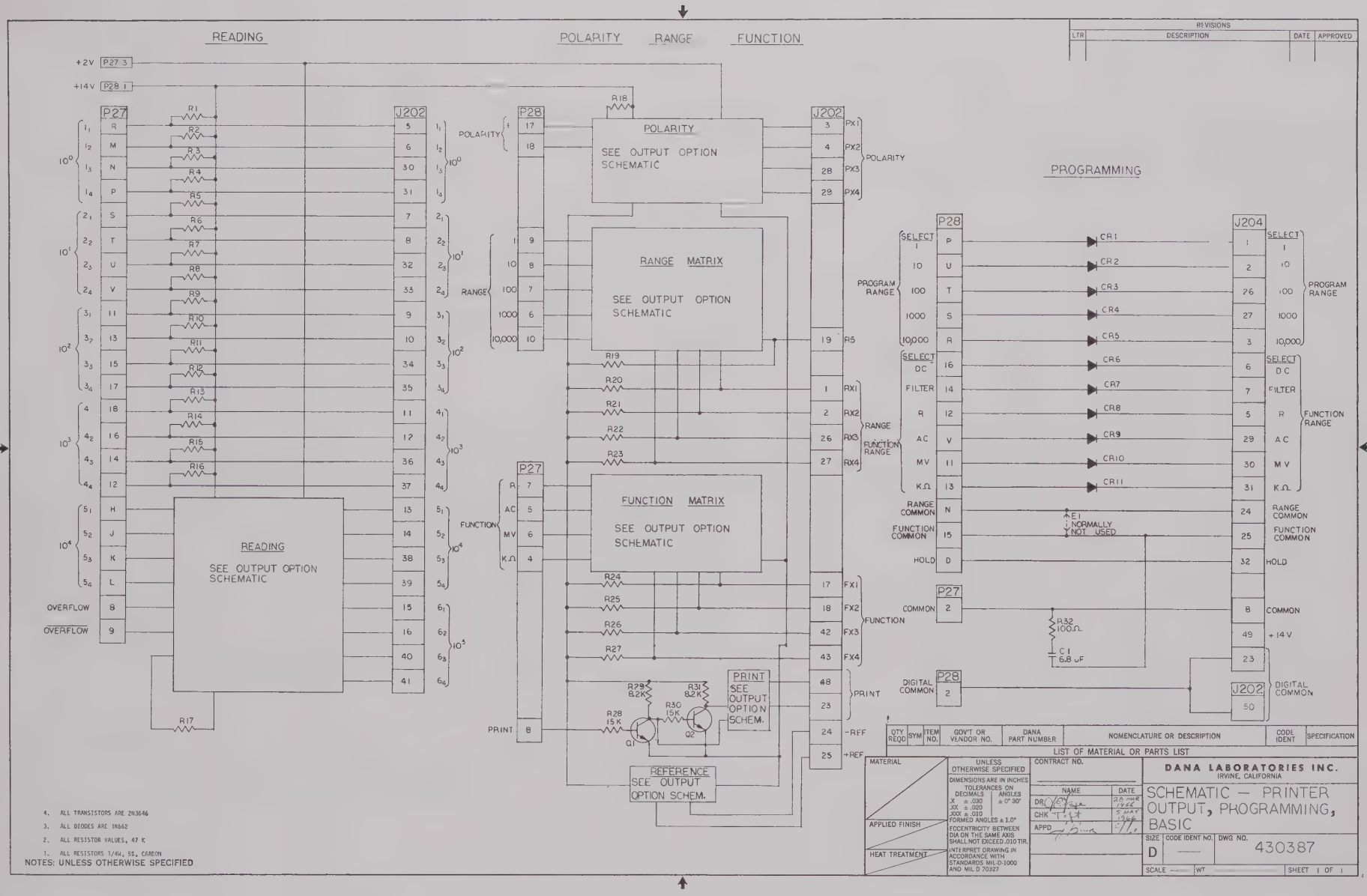
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — OUTPUT OPTION MODEL 61

SIZE D | CODE IDENT NO. — | DWG NO. 400867

SCALE 2/1 | WT — | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS 1/4W, 5%, CARBON
2. ALL RESISTOR VALUES, 47 K
3. ALL DIODES ARE IN662
4. ALL TRANSISTORS ARE 2N3646

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	20 MAR 1968
CHK	[illegible]	5 MAY 1968
APPD	[illegible]	[illegible]

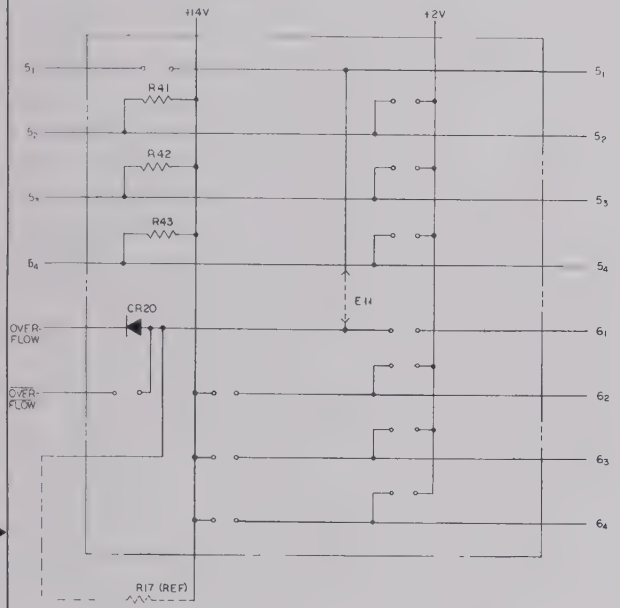
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — PRINTER OUTPUT, PROGRAMMING, BASIC

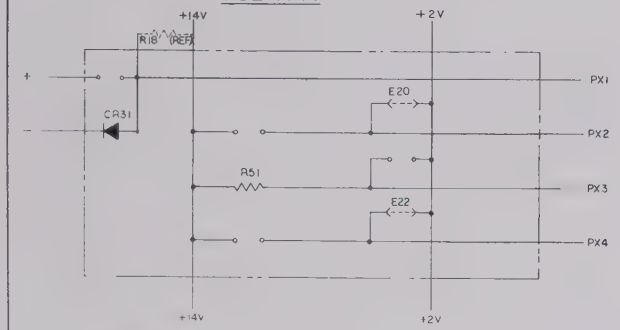
SIZE	CODE IDENT NO.	DWG NO.
D	—	430387

SCALE — WT — SHEET 1 OF 1

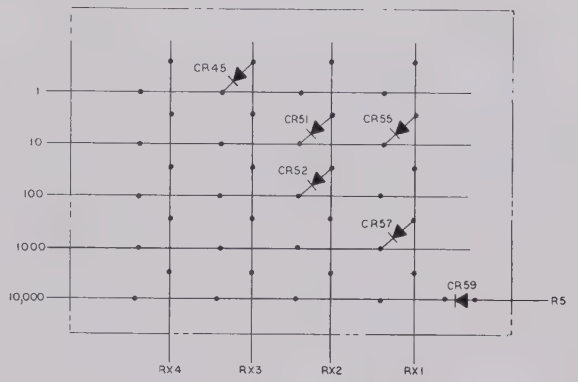
READING



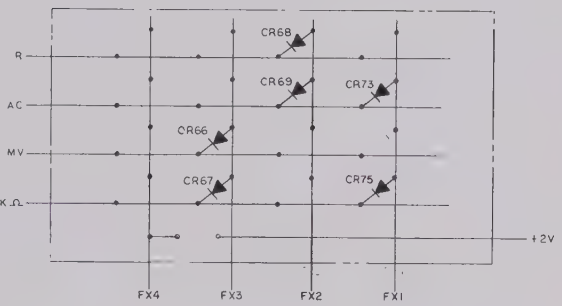
POLARITY



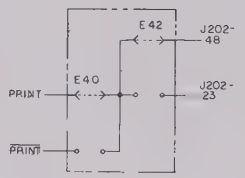
RANGE MATRIX



FUNCTION MATRIX



PRINT



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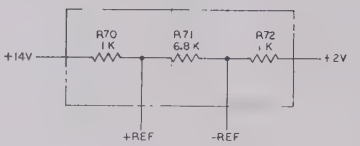


4. BASIC PRINTER AND PROGRAMMER SCHEMATIC: 430387
3. ALL DIODES ARE 1N662
2. ALL RESISTOR VALUES, 47 K
1. ALL RESISTORS 1/4W, 5%, CARBON

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL 0-1000 AND MIL-0-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	29 MAR 1966
CHK	[illegible]	2 APR 1966
APPD	[illegible]	5/1/66

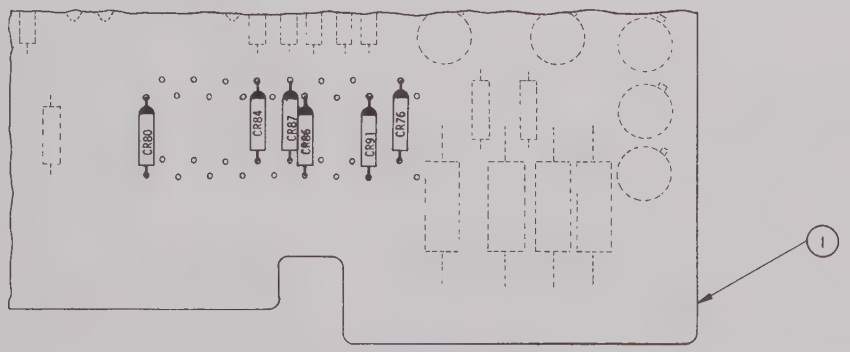
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - OUTPUT OPTION 61, 1-2-8 NEGATIVE TRUE

SIZE D | CODE IDENT NO. | DWG NO. 430388

SCALE | WT. | SHEET 1 OF 1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



400865

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
1		1		400862	P C BOARD ASSY - DECADE, BCD, BASIC	

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
	5400	4	4

APPLICATION — QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB—ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES: ± 0° 30'

MATERIAL: SEE L/M

APPLIED FINISH

DRAWN		1 FEB 1966
CHECK	Toft	8 FEB 1966
ENGR		
APPR		2/8/66

APPROVED

APPROVED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASSY - DECADE MATRIX 1-2-4-8

CODE IDENT NO. —— SIZE C 400865

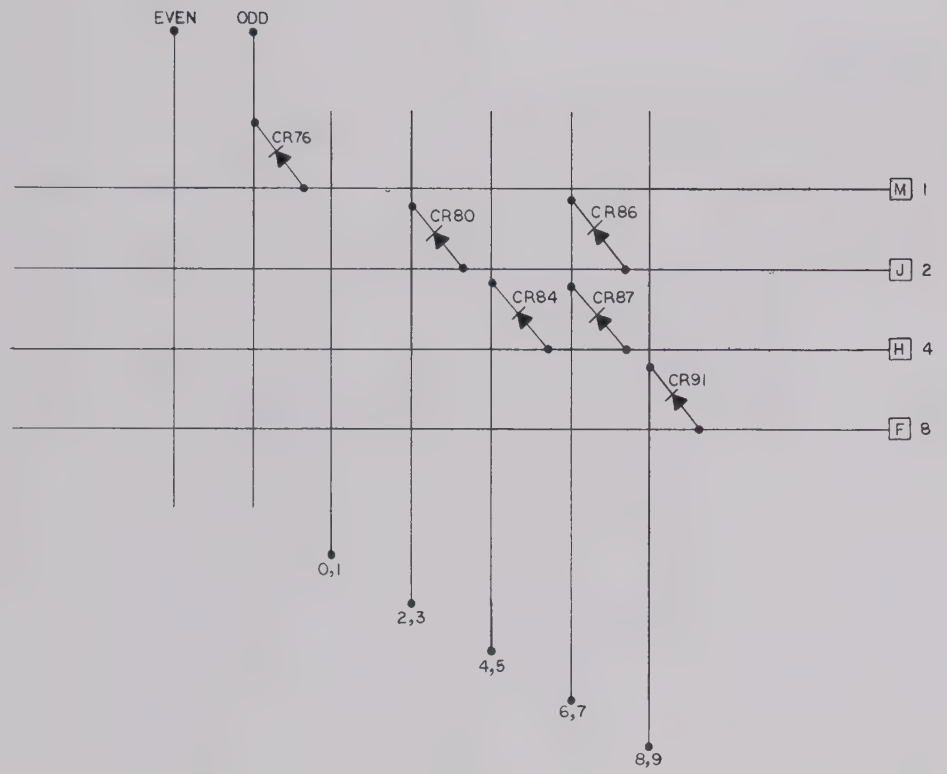
SCALE 2/1 WEIGHT —— SHEET 1 OF 1

1. All diodes are 1N662.

NOTES: UNLESS OTHERWISE SPECIFIED

586-00 LIETZ 1030 TOPP LIGHT 4-64

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



430365

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
					LIST OF MATERIALS OR PARTS LIST	

400865	5400	REF	REF
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.... SUB-ASSY MRA.. MAJOR REPL ASSY
MA.. MODULE ASSY CA... COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, .XX ± .020, .XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN		1 FEB 1966
CHECK		3 FEB 1966
ENGR		2/3/66
APPR		

APPROVED

APPROVED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC – DECADE MATRIX, 1-2-4-8

CODE IDENT NO.	SIZE	
	C	430365

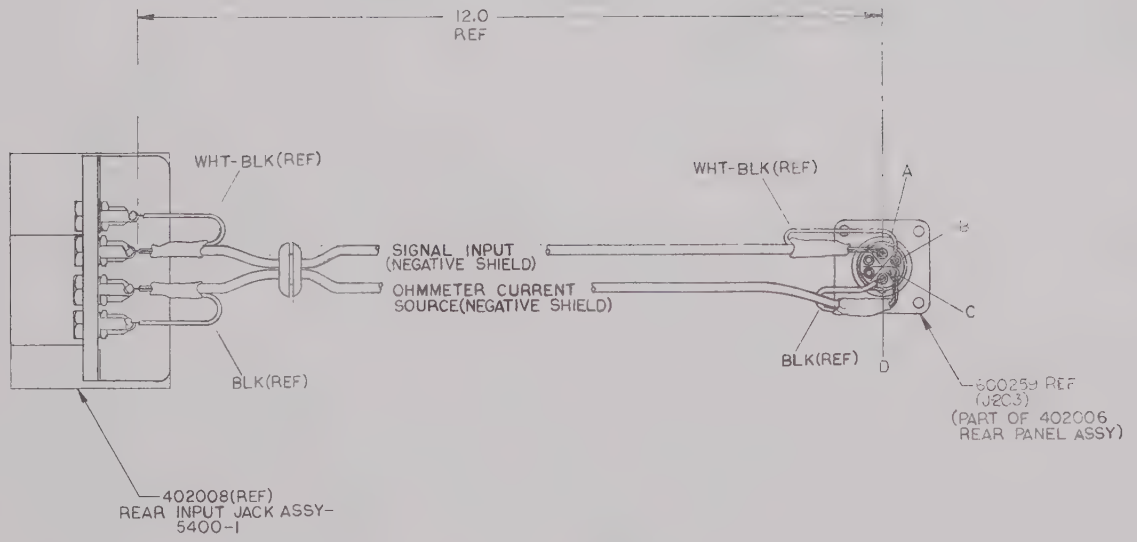
SCALE ——— WEIGHT ——— SHEET 1 OF 1

1. All diodes are 1N662.

NOTES: UNLESS OTHERWISE SPECIFIED

586-00 LIETZ 1030 TOPFLIGHT 4-64

DATE	APPROVED



QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON

DECIMALS	ANGLES
.X ± .030	± 0° 30'
.XX ± .020	
.XXX ± .010	

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	26 APR 1966
CHK	[illegible]	27 APR 1966
APPD	[illegible]	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM — ENCLOSURE, 5400-1

SIZE	CODE IDENT NO.	DWG NO.
C	———	430400

SCALE FULL | WT ——— | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

DANA LABORATORIES
Repair/Return Form

DANA MODEL NO. _____ SERIAL NO. _____

RETURNED ASS'Y. P/N _____ SERIAL NO. _____

PROPERTY OF _____

RETURN TO _____

DESCRIPTION OF TROUBLE _____

OPERATING CONDITIONS (ie: Environment, Source Z) _____

SIGNED _____ DATE _____

(USE BACK OF FORM IF NECESSARY)

REPAIR INFORMATION

(TO BE COMPLETED BY REPAIR FACILITY)

SYMPTOMS NOTED _____

ACTUAL CAUSE _____

REPAIRS REQUIRED _____

SIGNED _____ DATE _____

RETURN TO USER FILE

SM 10-65

Warranty

It is the practice of Dana Laboratories, Incorporated, to manufacture only products of a quality that will merit customer satisfaction. The company recognizes that customer satisfaction is achieved, not only by delivering products meeting advertised performance specifications and having a high level of reliability, but also by honestly and efficiently fulfilling their warranty obligations as set forth below.

Dana Laboratories, Inc., agrees to correct, either by repair or replacement, any defect of material or workmanship in Dana-manufactured units or components which develop within one year after delivery of the equipment to the original purchaser — provided that the equipment has been subjected only to normal and proper use.

In the event of failure of any component delivered with Dana equipment, but not manufactured by Dana Laboratories, assistance will be given the customer in obtaining, from the original manufacturer, reasonable adjustment under that manufacturer's warranty.

Any item claimed to be defective during the warranty period must be returned to Dana Laboratories, Inc., with transportation charges prepaid. The item will be repaired and returned to the purchaser with return transportation prepaid by Dana unless, of course, the item is found not to be defective or found to be damaged by misuse — in which case it will be returned to the purchaser with repair and transportation billed collect.

DANA

M

MP MASTER
MA30590